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Swallowing Difficulties in Elderly People: Impact of Maxillomandibular Wedging

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1. Introduction

Situated in a particular anatomic zone: the aero digestive crossroad, swallowing is going to allow the transport of the food from the oral cavity toward the stomach while protecting the upper air tracts [1-2]. The first phase of swallowing is a voluntary, necessary phase: the labiooral phase. It starts with the elaboration of the bolus: food is incised (with incisors), masticated (laterally and behind with molars), and impregnated with saliva. The lips, the cheeks, the tongue and the mandible are animated by rhythmic movements; the oral cavity must remain closed. Once the bolus is prepared, it is gathered in only one entity on the back of the tongue which forms a gutter [3-5]. At this stage, the mandible takes support on the jaw by dental contact so that the bolus can be expelled towards the base of the tongue, by the action of the tongue like a piston but also the lips which lean on the superior incisors. It is impossible to swallow with the mouth open without jaw stabilization [6-8]. During the pharyngeal phase, the bolus advances towards the oesophagus. The mechanisms of protection of the upper air tracts are implemented by successive rise of the palate, the hyoid bone and the larynx. The epiglottis topples over towards the back, comes to cover the supra-glottal floor. The crossing of the air and digestive tracts imposes a narrow coordination between pharyngeal phase and respiratory activity [1, 9].

In geriatrics, swallowing difficulties are frequent and remain a problem for the medical staff [10]. They manifest themselves most often during meals by signs from the simple cough of expectoration to the systematic false passage. One of the frequent complications is pulmonary infection which can aggravate the general health of the old person and be life-threatening [11-17].

During the labiooral time, different elements are important to consider: the viscosity, the volume and the homogeneity of the bolus, the peripheral musculature (lips, tongue, cheeks), the occlusal contacts, the jaw stabilization [9, 18, 19]. In elderly people, these elements are affected by frequent difficulties.

The neuromusculoarticular coordination and the driving performances of the orofacial region appear slightly influenced by ageing. Baum and Bodner [20] pointed out a muscular impairment of lips and muscles dependent on age. The speed and the amplitude of

mandibular vertical movements decrease with ageing. The study of Koshino et al [21] showed modifications of the shape and the speed of mastication cycles with age.

The neuromuscular disorders which characterize the frequent general pathologies in the elderly such as Parkinson's disease, Alzheimer's dementia, the consequences of cerebral strokes (hemiplegia), the muscular pathologies, all increase risks of dysphagia [14, 19, 22-24]. The movements of the tongue and chewing are strongly unsettled, and the ascent of the larynx and the hyoid bone are incomplete. It results in a partial persistence of the bolus in the oral cavity after swallowing, and a stagnation of particles in the pharynx [10-11].

The health status and a poor oral health of elderly people particularly in residential aged care facilities can be in origin or aggravate dysphagia [7; 24-28]. If food is not correctly crushed, not twisted and not impregnated with saliva, the bolus will be broken up, too dry, not homogeneous and can stagnate in the oral cavity without being able to be completely swallowed [8, 24, 29-32]. The adaptation of the texture of food and (mixed, smooth, thickened) drinks is the answer most usually adopted in geriatrics to resolve the problem of mastication and constitution of the bolus [10].

Moreover, an inadequate dental status (missing teeth, inadapted denture, edentulousness) prevents a correct maxillomandibular position and efficient jaw stabilization for swallowing. The occlusal contacts (with natural or prosthetic teeth) must be stable, balanced, and centered at the posterior teeth i.e molars and premolars to ensure a correct oral function [12, 16, 17, 30, 33-35].

If, during swallowing, the mandible cannot "settle" in the jaw, it will be pulled forwards, because of the architecture of the temporomandibular joint (which can be schematized as a plane tipped up forward): it is the mandibular protrusion [6, 12, 33]. The epiglottis is then pulled forwards; the hyoid bone and the larynx cannot rise correctly: the laryngeal tightness cannot be ensured and increases the risk of false passage [36]. Also, the absence of the posterior teeth (premolars and molars) is frequent among the old people. If this posterior edentulousness is not compensated with a removable denture or if the removable denture has prosthetic teeth which are inadequate (old, damaged), the patient then attains the maximum of anterior contacts to prop up his mandible and to avoid stiffness: this creates a mandibular protrusion [30]. The profile of the patient is characteristic: lower floor of the face reduced, chin positioned forward, cutaneous folds (nasogenian, labiogenian) accentuated. Among elderly people, a bad posture, a reduced muscular tonicity and an increased ligamentary laxity accentuate the subsidence of the tissues and the mandibular protrusion [37].

The purpose of this preliminary study is to assess swallowing disorders and the oral and dental status among an elderly population living in a long-term care unit.

2. Materials and methods

The study was carried out on residents of the long-term care unit of Toulouse Hospital (geriatrics university center). This unit admits patients with a high level of disability and very poor general health (mean life expectancy of 2 years). All resident of the unit were screened. To be eligible for inclusion, subjects were required not to be fed by percutaneous endoscopic gastrostomy (PEG) and to accept to participate in the study. Enrolment lasted 1 month.

Baseline age, sex, current sialoprive medication (number of medication, psychotropic treatments [anxiolytics, neuroleptics, serotonin reuptake inhibitors, and other antidepressants] and antihistaminic) were recorded.

Disability was assessed using the Katz's disability scale [38]. Each item (eating, transferring from bed to chair, walking, using the toilet, bathing, and dressing) was scored from 0 to 1 (0 = unable to perform the activity without complete help, 0.5 = able to perform the activity with little help, 1 = able to perform the activity without any help). The scoring system gave a score range from 0 to 6. The body mass index ($BMI = \text{weight (kg)} / \text{height}^2 \text{ (m}^2\text{)}$) was calculated at baseline.

An assessment of the swallowing disorders and the oral status were carried out by a trained geriatrician and an odontologist using two observational scales. The first was a meal observation, serving for estimating dysphagia. It was elaborate and used by the Toulouse otorhinolaryngology department. The assessment was performed once, during a usual midday meal. The variables collected were listed and described in the table 1.

Variables	Description
Sitting down	Sitting position, wedged head with support head or cushion
Assistance	No assistance, complete or partial assistance
Texture of food	Normal, tender, soft, smooth or mixed texture
Texture of drinks	Liquid or thickened drinks
Type of mastication	Vertically mastication when the mandibular movements are regular and well centred on the jaw during the chewing Disrupted mastication when the mandibular movements are backward and forward horizontally.
Coughing before/ after having swallowed	Coughing before having swallowed if there is a disease of labiooral phase (explained by the bolus constituting badly or the delay of the ascent of the larynx) Coughing after having swallowed if there is a disease of pharyngeal phase (explained by a bad tightness of the larynx or the food stagnating in the epiglottis fold)

Table 1. Summary of variables used for meal observation

The second was an oral examination in order to estimate the oral status. It was elaborate and is used by the odontology department of Toulouse. The oral status is illustrated by a quantitative dental status and a functional dental status. The variables collected were listed and described in the table 2.

3. Results

Forty patients (31 women and 9 men) were recruited from 53 residents. Ten patients refused and three patients had a PEG. The mean age of the patients was of 85.2 years with range of 63-100 years for the women and of 68-87 years for the men. Patients were dependant (mean ADL score = 2,125 (mini = 0; maxi = 5)). Twenty two participants needed assistance (22,7% partial, 77,3% complete) during the meal. The patients took on average 6 different medicines per day among which 1 medicine, on average was sialoprive. Fifteen patients took no sialoprive medicine. The mean BMI was 23 (mini = 12,21; max = 36,83).

Variables	Description
Quantitative dental status	Number of maxillary or mandibular missing teeth Presence of partial or complete removable dentures
Functional units (FU)	Number of opposing natural or prosthetic tooth pairs which are going to be in contact during the chewing and during the swallowing [30]. The anterior functional units (ant FU) represent incisors and canines. The posterior functional units (post FU) represent premolars and molars. If the patients have a complete dentition, they have 8 posterior functional units, but if they are complete edentulous, they have no functional unit.
Maxillomandibular wedging	It is assured by the presence of natural or prosthetic anterior functional units (incisive or canines) and\ or by the presence of natural or prosthetic posterior functional units (premolars or molars).
Vertical Dimension of Occlusion (VDO)	It is the dimension measured on the median sagittal plane between a point situated on the face and a point situated on the mandible when teeth are in intercuspidal position i.e in maximum intercuspitation. When it exists neither wedging, nor later functional units, the VDO cannot be measured. When the natural or prosthetic teeth are inadequate (worn or damaged), the VDO is decreased.
Protrusion	It is connected to a disturbance of the intermaxillary relation i.e the mandible slips forward during closing.

Table 2. Summary of variables used for quantitative and functional dental status

3.1 Installation-assistance

Wherever the meal took place (bed room or dining room), the nursing staff were careful to sit down the patient properly: sitting position for the majority of patients, with wedged head with support or cushion. One patient could not be correctly settled because he presented an inflexible bending of the head. More than half of the patients (55 %) needed a complete or partial assistance.

3.2 Texture of food and drinks

The liquid drinks where consumed by 75 % of the patients; the texture of food (7,5% tender, 10% soft, 22,5% smooth or 45% mixed) was adapted for 85 % of the patients.

3.3 Type of mastication

52 % of the patients masticated vertically.

3.4 Dysphagia

35 % of the patients coughed before and\or after swallowing: 4 patients coughed before having swallowed, 4 patients coughed after having swallowed, 6 patients coughed before

and after having swallowed during the same meal. 26 patients (65 %) did not show signs of coughing.

3.5 Quantitative dental status

On average, the studied population presented 21.7 absent teeth (on 32 teeth) of which 11.7 missing teeth in the maxilla and 10 missing teeth in the mandible. In spite of the large edentulousness (~ 21 teeth / 32 teeth), the number of patients wearing removable prosthesis was few: 25 % of the patients (7 complete dentures, 3 partial removable dentures). On 9 edentulous patients, 7 wore complete dentures.

3.6 Functional dental status

40 % of the patients (16 patients) had no maxillomandibular wedging: for them, there was no functional unit. 60 % of the patients (24 patients) had a maxillomandibular wedging: 8 patients owing to the presence of ant FU, 16 patients owing to the presence of post FU. The 6 patients who have 8 FU post i.e the maximum number of functional units are edentulous wearing complete dentures.

A vertical dimension of occlusion (VDO) exists of the patients who had a wedging, that were 60 % of the patients (24 patients). VDO is decreased at 1/3 of the patients.

37,5 % of the patients (15 patients) presented a mandibular protrusion: 3 patients wore complete dentures with a decreased VDO, 8 patients had no FU post and no wedging, 3 patients had no post FU but had a wedging owing to the presence of anterior teeth, 1 patient had 5 post FU with a correct VDO.

4. Discussion

Among 24 patients who had a maxillomandibular wedging due to the presence of anterior FU (8 patients) or posterior FU (16 patients), only 5 patients presented swallowing difficulties.

Two patients who had a posterior wedging ie posterior FU cough during the meal, they present mandibular protrusion: it can be explained by an insufficient wedging (2 to 4 FU instead of 8). Three patients, who had a wedging with anterior FU, coughed during the meal and did not chew vertically. They also presented a mandibular protrusion explained by the lack of posterior contacts.

The swallowing difficulties for these five patients can be explained by an unstable wedging: because of the mandibular protrusion, the epiglottis blocks incorrectly the upper air tracts and so these patients do not chew vertically.

All the patients who had a wedge due to natural posterior teeth chew vertically.

Six complete denture wearers did not present swallowing difficulties: these prostheses assured a reproducible and reliable wedging. Among these patients, four patients chewed vertically and two others did not chew vertically: they wore a worn complete denture, with a decreased VDO. Imaizaki et al [33] show the roles of prosthetic teeth during swallowing: particularly supporting the function of the tongue to perform skillful movements for the

passage of food to the oropharynx and maintaining the mandible in a constant position near the intercuspal position i.e. without protrusion.

Among 16 patients who had no maxillomandibular wedging, 14 present swallowing difficulties and had an uncoordinated chewing.

Two patients without wedging and without dysphagia maintained a vertical chewing. They wore complete dentures, but a very recent loss of these prostheses could explain the persistence of a "reflex of chewing".

The dental status was very poor for the patients who had no wedging: they had 14 absent teeth by arch and more than two roots, while the patients who had a maxillomandibular wedging have 4 absent teeth on average and less than one root.

All the patients who needed a partial or total assistance seemed predisposed to dysphagia: they had disrupted chewing and/or coughed before or after having swallowed and/or spat out their food. One patient who needed no assistance to eat coughed during swallowing. This could be explained by a very poor oral state and thus a bad constitution of the food bolus.

One patient had complete dentures which allowed him to make correct wedging, with a correct VDO and without protrusion. He benefited from partial help during the meals of mashed food. He absorbed no sialoprive medicine. He did not present swallowing difficulties but chewed incorrectly. This fact can be explained by the inflexible bending of the head which never allowed him to sit down properly.

It is difficult to correlate the oral status of the patients and the swallowing difficulties to textures of food and drinks. The dietician always gave his viewpoint without dental status. Also, the textures of food and drinks were not re-evaluated regularly.

It is difficult to correlate the functional status (particularly the maxillomandibular wedging) and the cough: the patients who have no FU cough sometimes before or sometimes after having swallowed during the same meal. The oral phase and the pharyngeal phase cannot be dissociated during the meal observation. But the cough is constant for these patients.

The study carried out by Kayser-Jones et al. [39] with a similar population (institutionalized old patients) observed for 6 months emphasized the crucial role of the medical staff for the sitting down of the patients, the position of the head and the help in eating to the meals but also the adaptation of the texture of food. On the other hand, no dental or prosthetic data are taken into account.

5. Conclusion

The starting of swallowing is situated in the mouth and more exactly on the dental arcades: the natural or artificial teeth incise, crush, and mix food with saliva, the tongue, the lips and the cheeks until the bolus is formed. Then, the jaw is stabilized by an efficient maxillomandibular wedging during the bolus expulsion towards the oesophagus. This description points out the importance of the maxillomandibular position during the function of masticating-swallowing.

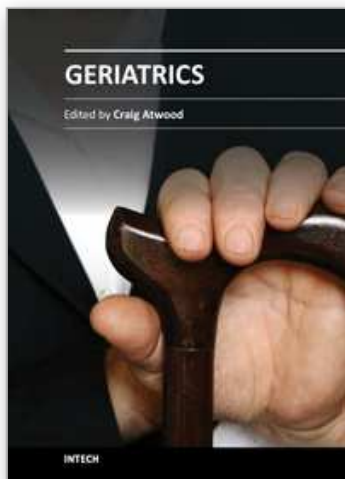
This descriptive study shows frequent associations between the oral and dental status, the maxillomandibular wedging and the dysphagia among a representative population living in the long-term care unit i.e older patients who have a poor general health and take some

medicines. Moreover, the absence of a correct wedging and particularly premolomolar wedging and also a disrupted mastication seem to be factors causing dysphagia. So, the improvement of functional oral status and the preserving of dental status seem to be good objectives to prevent dysphagia.

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Geriatrics

Edited by Prof. Craig Atwood

ISBN 978-953-51-0080-5

Hard cover, 246 pages

Publisher InTech

Published online 24, February, 2012

Published in print edition February, 2012

With the baby boomer generation reaching 65 years of age, attention in the medical field is turning to how best to meet the needs of this rapidly approaching, large population of geriatric individuals. Geriatric healthcare by nature is multi-dimensional, involving medical, educational, social, cultural, religious and economic factors. The chapters in this book illustrate the complex interplay of these factors in the development, management and treatment of geriatric patients, and begin by examining sarcopenia, cognitive decline and dysphagia as important factors involved in frailty syndrome. This is followed by strategies to increase healthspan and lifespan, such as exercise, nutrition and immunization, as well as how physical, psychological and socio-cultural changes impact learning in the elderly. The final chapters of the book examine end of life issues for geriatric patients, including effective advocacy by patients and families for responsive care, attitudes toward autonomy and legal instruments, and the cost effectiveness of new health care technologies and services.

How to reference

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Marie-Hélène Lacoste-Ferré, Sophie Hermabessière and Yves Rolland (2012). Swallowing Difficulties in Elderly People: Impact of Maxillomandibular Wedging, Geriatrics, Prof. Craig Atwood (Ed.), ISBN: 978-953-51-0080-5, InTech, Available from: <http://www.intechopen.com/books/geriatrics/swallowing-difficulties-in-elderly-people-impact-of-maxillomandibular-wedging>

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