図13　口腔リハビリテーション多摩クリニックのコンセプト

食とコミュニケーションの リハビリテーション

- 摂食・嚥下障害者に対するリハビリテーション
- コミュニケーション障害患者に対するリハビリテーション
- 摂食・嚥下障害患者に対する食事・栄養指導
- 摂食・嚥下障害者に対する口腔ケア
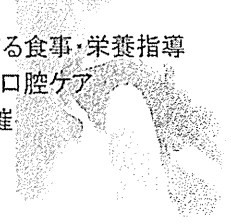- 食支援カンファレンスの開催

図14　食とコミュニケーションのリハビリテーション

スペシャルニーズ デンティストリー

- 障害児歯科診療

- 寝たきり高齢者歯科診療

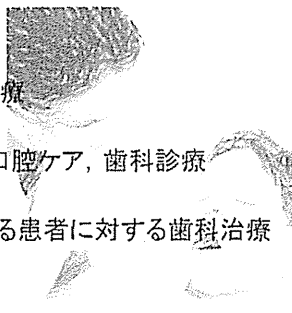- 口腔咽頭がん患者の口腔ケア，歯科診療

- スペシャルニーズのある患者に対する歯科治療

図15　スペシャルニーズデンティストリー

食の研究センター 食の研修センター

- 食の研究センター

- 食支援研修会の開催

　　多摩クリニック摂食嚥下研修会
　　専門職向け研修会開催
　　実技，実習付き研修会の開催
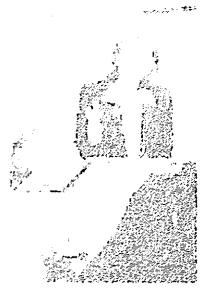　　　　　　　　　　など

図16　食の研究・研修センター

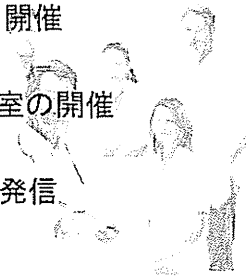## 食の健康プラザ

- 市民向け「食の元気塾」開催

- 離乳食教室，介護食教室の開催

- 食の健康に関する情報発信

図17　食の健康プラザ
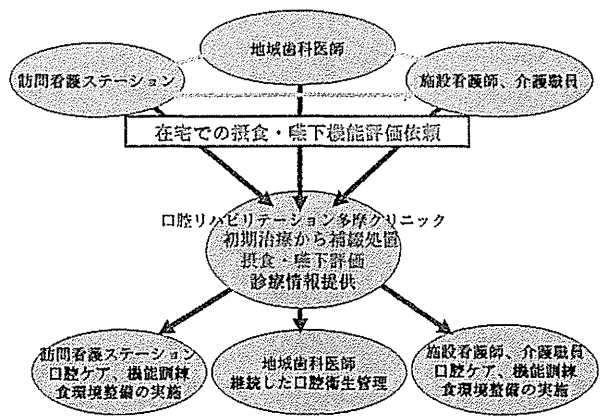
図18　在宅を支える連携

このような取り組みを通して我々は，口腔リハビリテーション多摩クリニックを通し，地域の医療，介護，福祉と連携して地域住民の口腔機能を支えることを目指したい（図18）。

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—— 原 著 ——

介護老人福祉施設入居者における2年間の
専門家による定期的な歯面清掃の効果

Effect of Regular Professional Supragingival Plaque Control
in Elderly Nursing Home Residents : A Two-Year Study

関野　　愉[1], 菊谷　　武[2], 田村　文誉[2]
久野　彰子[3], 藤田　佑三[1], 沼部　幸博[1]

Satoshi Sekino[1], Takeshi Kikutani[2], Fumiyo Tamura[2]
Akiko Hisano[3], Yuzo Fujita[1] and Yukihiro Numabe[1]

抄録：本研究は，要介護高齢者に対して定期的な専門家による歯肉縁上プラークコントロールを2年間継続した場合の歯面清掃状態および，歯周組織に及ぼす影響を明らかにすることを目的として遂行された。東京都台東区の特別養護老人ホーム入居者88名（平均年齢81.8±9.1歳）を対象とした。転居や死亡により39名を除外した。研究開始時（BL）から，15名の入居者には，日常のブラッシング（入居者自身，あるいはヘルパーによる）に加え，歯科衛生士による週に一度の歯肉縁上プラークコントロールが行われた（介入群）。他の34名には入居者自身またはヘルパーによるブラッシングが行われた（対照群）。BLと2年後に，プロービング・ポケット・デプス（PPD），臨床的アタッチメント・レベル（CAL），プロービング時の出血（BOP），プラーク指数（PlI）の記録を行った。平均PlIは介入群においては2年間で0.3±0.4減少し，対照群では0.1±0.8増加し，両群間に統計学的有意差がみられた（p<0.05）。平均PPD，平均CALおよび平均BOPに関しては両群間で統計学的有意差がみられなかった。また，介入群においては199歯中17歯（8.5%）喪失し，対照群においては311歯中36歯（11.6%）が喪失した。この結果から歯科衛生士によるシステム化された専門的口腔ケアにより，介護老人福祉施設入居者の歯面清掃状態が改善されることが証明された。今後は厳密な口腔衛生プログラムを導入した大規模な研究が必要である。

キーワード：介護老人福祉施設入居者，歯科衛生士，プラークコントロール，歯周炎，歯の喪失

緒　　言

近年，日本において高齢者人口は増加し，平成23年には総人口の約23.3%に達した。高齢化にともない，要介護高齢者の人口も年々増加している。

東京都および山梨県において行われた調査では，要介護高齢者の3分の1以上が歯周炎に罹患していたことが報告されている[1]。歯周炎の進行は，歯の動揺の増加や歯の喪失を招き，その結果口腔機能が低下することになる。

歯周組織の健康状態を維持，増進させるためには，口腔衛生の水準を高めることが重要である[2]。しかしながら介護施設入居者の口腔衛生状態は，全身機能や認知機能の低下により，自力で口腔清掃を行うことが困難であり，一般的には不良である[1,3~6]。そのため，介護士等の第三者により清掃が行われることが望ましいが，介護士の口腔の健康

[1] 日本歯科大学生命歯学部歯周病学講座
[2] 日本歯科大学口腔リハビリテーション多摩クリニック
[3] 日本歯科大学附属病院総合診療科
[1] Department of Periodontology, School of Life Dentistry at Tokyo, The Nippon Dental University
[2] Tama Oral Rehabilitation Clinic, The Nippon Dental University, Dental Hospital
[3] Division of General Dentistry, The Nippon Dental University Hospital

に対する関心の低さ，適切な口腔ケアを行う知識や技術の欠如，口腔衛生の優先順位の低さなどの問題がある。したがって，専門的な知識，技術に基づいた特別な口腔衛生プログラムの導入が必要である。現在まで，口腔衛生プロトコールの実施や看護師や介護士の教育などにより，口腔衛生が短期的には改善したという報告がある[7,8]。一方，歯面に付着しているプラークには影響がなかったという報告もある[9]。これらのことから，安定した結果を得るためには，歯科医師，歯科衛生士などの専門家による介入を含んだ定期的なプラークコントロールが有効と思われる。また，専門家によるプラークコントロールがプロービング・ポケット・デプス，臨床的アタッチメント・レベル，プロービング時の出血などの歯周病学的パラメータにどのように影響するかは不明である。

　本研究は，歯科衛生士による歯肉縁上プラークコントロールを2年間継続した場合の，歯面清掃状態および歯周組織に及ぼす影響を明らかにすることを目的とした。

対象および方法

1．対象者

　東京都台東区の特別養護老人ホーム5施設の入居者で歯を有する88名（平均年齢81.8±9.1歳）を対象とした。

2．介入方法

　研究開始時（BL）から2年間，2施設における27名の入居者では，日常のブラッシング（入居者自身，あるいは介護士による）に加え，歯科衛生士による週に一度の歯肉縁上プラークコントロールが行われた（介入群）。歯科衛生士によるプラークコントロールはシングルタフトブラシ，歯間ブラシおよび歯ブラシ，フッ化ナトリウム配合歯磨剤または0.05％クロルヘキシジン配合洗口剤を使用し，一人につき3〜10分行われた。他の3施設の入居者61名では自身またはヘルパーによるブラッシングが行われた（対照群）。対象者または家族および各施設には歯周疾患の検査を行うこと，口腔衛生に関する介入を行うこと，および検査結果を個人が特定できない形で公表する承認を書面にて得た。本研究は日本

歯科大学生命歯学部倫理委員会の承認を得て行われた（承認番号2110）。

3．検査項目

　BLと2年後に現在歯数などを含む一般的な歯科検診の他に，以下の歯周病パラメータについて，2名の歯周病専門医が，TUCLプローブ，Williamsタイプ（株式会社シオダ）を用い，4点法により智歯および残根を除くすべての現在歯について計測を行った。

　1）プラーク指数（PlI, Silnessと Löe, 1964）[10]
　スコア0：歯面が清潔
　スコア1：歯面は清潔にみえるが鋭利なプローブを用いて歯肉面3点からプラークが除去できる
　スコア2：視認できるプラーク
　スコア3：多量のプラークで歯面が覆われている。

　2）プロービング・ポケット・デプス（PPD）
　手用プローブにより，歯肉辺縁から歯周ポケット底部までの距離を1mm単位で測定した。

　3）臨床的アタッチメント・レベル（CAL）
　手用プローブにより，セメント-エナメル境または修復物辺縁から歯周ポケット底部までの距離を1mm単位で測定した。

　4）プロービング時の出血（BOP）の有無
　手用プローブを歯周ポケットに挿入した後，10秒以内に出血がみられた場合をBOP陽性として記録した。

　研究開始前に，2名の測定者がプロービングの再現性を高めるための打ち合わせと確認を行った。無作為に選ばれた5名の入居者に対して，全顎のプロービングを2度ずつ行った結果，PPDとCALについて同一測定者および測定者間の標準偏差が0.5未満で，±1mmの範囲で一致する確率は95％となった。

4．データの分析

　各群の男女比，平均年齢，平均現在歯数の各パラメータのBLと2年後のデータの差の2群間の統計学的有意差をt検定により解析した。また2群間の要介護度，食形態の分布，口腔乾燥の有無および喪失歯数の差はカイ二乗検定により解析した。

表1　介入群，対照群の男女比，平均年齢，平均現在歯数

	N（男/女）	平均年齢 （S.D.）	平均現在歯数 （S.D.）
介入群	15　（10/5）	80.5(8.4)	11.3(6.5)
対照群	34（13/21）	79.6(9.0)	10.7(7.7)

表2　介入群，対照群における背景因子

		介入群	対照群
要介護度(%)	1	13.3	3.2
	2	6.7	3.2
	3	26.7	16.1
	4	46.7	58.1
	5	6.7	19.4
食形態(%)	普通食	53.8	44.1
	きざみ食	34.6	35.3
	流動食	7.7	5.9
	経管	3.8	14.7
口腔乾燥あり(%)		25.9	36.4

研究期間中，39名（介入群12名，対照群27名）が転居または死亡したため，解析から除外した。その結果，介入群15名，対照群34名が解析対象となった。

結　　果

表1に各群の被験者の男女比，平均年齢，平均現在歯数，表2にその他の各群の背景因子を示す。介入群と対照群とで統計学的有意差はみられなかった。

平均PII は，介入群においては2年間で 0.3 ± 0.4 減少し，対照群では 0.1 ± 0.8 増加し，両群間に統計学的有意差がみられた（$p < 0.05$，図1）。平均PPD は介入群では 2.4 ± 0.3 mm から 2.6 ± 0.3 mm に，対照群では 2.5 ± 0.4 mm から 2.8 ± 0.4 mm に増加した（図2）。平均CAL は介入群では 4.1 ± 1.3 mm から 4.1 ± 1.0 mm と大きな変化はなかったが，対照群では 3.6 ± 1.3 mm から 3.8 ± 1.0 mm に増加した（図3）。平均BOP は介入群では $28.5 \pm 14.6\%$ から $36.9 \pm 18.0\%$ に，対照群では $31.2 \pm 21.1\%$ から $40.1 \pm 23.6\%$ に増加した（図4）。しかしながら，平均PPD，平均CAL，平均BOP のBL から2年後の変化量に関して，2群間で統計学的有意
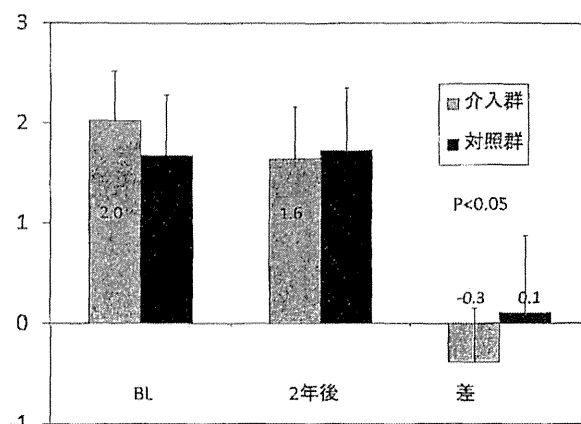
図1　介入群，対照群における平均PII（±S.D.）
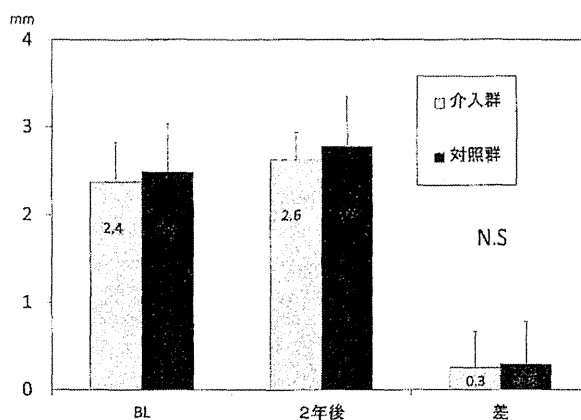

図2　介入群，対照群における平均PPD（mm，±S.D.）

差はみられなかった。

BL から2年後の間に，介入群においては199歯中17歯（8.5%）喪失し，対照群において311歯中36歯（11.6%）が喪失したが，2群間で統計学的有意差はみられなかった（表3）。

考　　察

本研究では，介護老人福祉施設入居者において，週に一度歯科衛生士が歯肉縁上プラークコントロールを行う口腔衛生プログラムを2年間継続した被験者において，従来の口腔衛生習慣が継続された対照群と比較して，プラークスコアが有意に改善された。MacEntee ら[11]の報告では，介護士が口腔の健康に関する講義を歯科衛生士から教育を受けた看護教育者から受講し，その後3カ月間，無制限に口腔の健康に関するアドバイスを受けたが，施設入居者の口腔衛生に影響しなかった。また，De Visschere
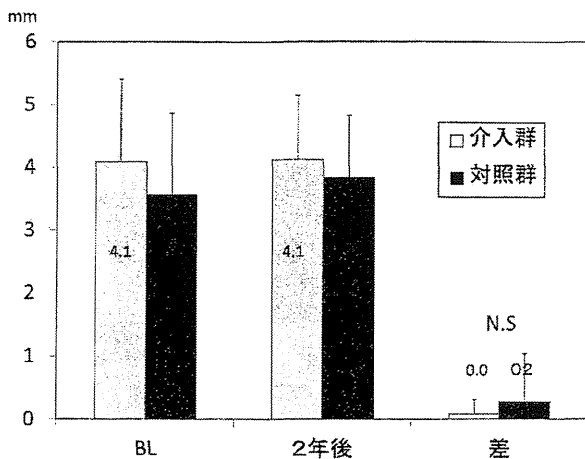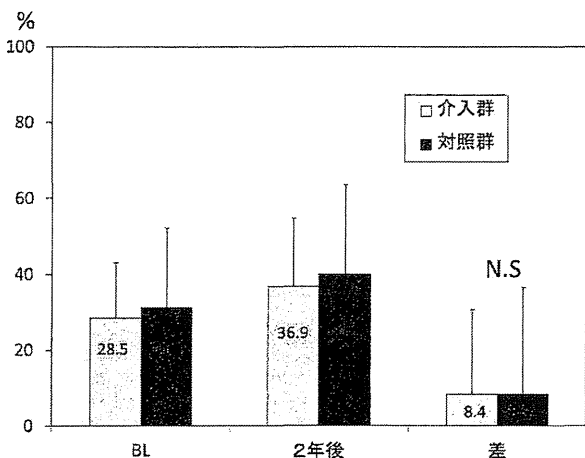
図3　介入群，対照群における平均CAL（mm，±S.D.）

図4　介入群，対照群における平均BOP（%，±S.D.）

表3　介入群，対照群における2年間での歯の喪失状況

	喪失歯率（%）	喪失歯数/BL時の現在歯数
介入群	8.5	17/199
対照群	11.6	36/311

ら[13]は，慢性歯周炎患者の5mm以上の歯周ポケットを対象とした研究で，ブラッシング指導および週に2〜3回の専門家による口腔清掃を30週間継続した場合，骨縁上ポケット，骨縁下ポケット，根分岐部病変のいずれの場合でも，歯肉縁下の細菌数，*Porphyromonas gingivalis*の比率の減少がみられたことを報告した。Ximénez-Fyvieら[14]の，週に一度専門家によるプラークコントロールを1年間継続した研究も同様の結果が得られている。他方，歯肉縁上プラークコントロールは歯肉縁下の細菌層に影響を与えなかったとの報告もあり[15,16]，さらにWestfeltら[17]は，PPD7mm以上の部位に3年間歯肉縁上プラークコントロールを継続したのみで，歯肉縁下のデブライドメントを行わなかった結果，約3分の1の部位にアタッチメントロスが起こったことを報告している。

　これらの結果の違いについての解釈は困難であるが，プラークコントロールの水準や頻度，歯周炎の程度の違い等が影響したと考えられる。本研究においても歯肉縁上プラークコントロールが定期的に行われた介入群でプラーク指数の平均値が改善はしたものの，プラークスコア2以上を示した歯面の割合は61.8%で，前述のHellströmら[13]の研究で20%以下であったことと比較すると歯面清掃状態は悪く，そのことが歯周病学的パラメータの改善に繋がらなかった可能性が考えられる。歯面清掃状態が対照群と比較して改善したことから，専門家による継続的な歯面清掃そのものの効果は期待できると考えられるが，歯周病学的パラメータを改善させ得るものにするためには，週に2〜3度歯面清掃を行うなど，介入の回数を増やすことや，介護職員への口腔衛生についての教育の徹底などが必要と考えられる。

　介入群において歯の喪失数が少なくなる傾向がみられたが，統計学的有意差はみられなかった。高齢者における歯の喪失原因の多くはう蝕とそれに関連

ら[9]は，ガイドラインに基づいた口腔衛生プロトコールの実施にあたり，専門家による教育，監視が行われた場合，デンチャープラークに対しては効果があったが，舌や歯面に付着したプラークに対しては効果がなかったことを報告した。本研究においては，介護士への特別な教育は行われていないが，プラーク形成量が有意に減少したのは，専門家の介入頻度や技術の影響と考えられる。

　PPD，CAL，BOPの変化に関しては介入群と対照群で差異がみられなかった。歯肉縁上プラークコントロールの歯周炎に対する効果についてはいくつかの報告がある。Dahlénら[12]は，一般市民に対して口腔衛生指導を3カ月間行った結果，2年後に，歯肉縁下の細菌数の減少や歯周病関連細菌の比率の減少がみられたことを報告した。さらにHellström

した要因があるという報告[18]や，義歯の鉤歯がリスクとなるという報告[19]もあり，歯周疾患以外の原因への対応が今後必要であろう。さらに，プラークコントロールの改善度をより高めるための，新たな口腔衛生プログラムを立案する必要があると考えられる。

結　論

専門家による週に一度のプラークコントロールを2年間継続した結果，対照群と比較して，

1．歯面清掃状態が有意に改善した。

2．平均CALは増加しなかったが有意な差はみられなかった。

3．平均PPD，平均BOPに有意差はみられなかった。

4．歯の喪失率が少ない傾向があったが統計学的有意差はみられなかった。

今後は，口腔衛生プログラム，介入の頻度や方法の改善，う蝕予防処置の導入などを取り入れた上で，長期的かつ大規模な研究を行う必要があると考えられた。

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Effect of Regular Professional Supragingival Plaque Control in Elderly Nursing Home Residents : A Two-Year Study

Satoshi Sekino[1], Takeshi Kikutani[2], Fumiyo Tamura[2], Akiko Hisano[3], Yuzo Fujita[1] and Yukihiro Numabe[1]

[1] Department of Periodontology, School of Life Dentistry at Tokyo, The Nippon Dental University
[2] Tama Oral Rehabilitation Clinic , The Nippon Dental University, Dental Hospital
[3] Division of General Dentistry, The Nippon Dental University Hospital

The purpose of this study was to clarify the effect of regular professional supra-gingival plaque control over 2 years on the dental hygiene status and periodontal conditions of elderly in need of care. The subjects were 88 nursing home elderly (mean age : 81.8 ± 9.1 years) in Taito-ku, Tokyo. Thirty nine subjects were excluded because they either moved away or died. Fifteen residents received weekly supra-gingival plaque control performed by dental hygienists in addition to habitual tooth brushing methods by themselves and/or helpers (intervention group) for a baseline. In another 34 subjects, self-performed tooth brushing and/or brushing by helpers were continued (control group). Probing pocket depth (PPD), clinical attachment level (CAL), bleeding on probing (BOP), plaque index (PlI) were recorded at baseline and 2 years. Reduction of mean PlI in the intervention group was 0.3 ± 0.4 in 2 years, while in the control group, mean PlI increased by 0.1 ± 0.8. The differences were statistically significant ($p < 0.05$). There were no statistically significant differences with respect to mean PPD, mean CAL and mean BOP between the groups. In the intervention group, 17 out of 199 teeth were lost (8.5%), while 36 out of 311 teeth were lost (11.6%) in the control group. These results demonstrated that systemic professional oral care performed by dental hygienist improved the oral hygiene status in elderly residents in nursing homes. A further large-scale study on the introduction of a meticulous oral hygiene program is necessary.

Key words : elderly residents in nursing home, dental hygienist, plaque control, periodontitis, tooth loss

Tongue Thickness Relates to Nutritional Status in the Elderly

**Fumiyo Tamura · Takeshi Kikutani ·
Takashi Tohara · Mitsuyoshi Yoshida ·
Ken Yaegaki**

Abstract Many elderly people under long-term care suffer from malnutrition caused by dysphagia, frequently leading to sarcopenia. Our hypothesis is that sarcopenia may compromise oral function, resulting in dysphagia. The objectives of this study were to evaluate sarcopenia of the lingual muscles by measuring the tongue thickness, and elucidate its relationship with nutritional status. We examined 104 elderly subjects (mean age $= 80.3 \pm 7.9$ years). Anthropometric data, such as triceps skinfold thickness and midarm muscle area (AMA), were obtained. The tongue thickness of the central part was determined using ultrasonography. Measurement was performed twice and the mean value was obtained. The relationship between tongue thickness and nutritional status was analyzed by Pearson's correlation coefficient and Spearman's rank correlation coefficient. AMA and age were identified by multiple-regression analysis as factors influencing tongue thickness. The results of this study suggest that malnutrition may induce sarcopenia not only in the skeletal muscles but also in the tongue.

Keywords Tongue thickness · Nutritional status · Dysphagia · Sarcopenia · Ultrasonography · Deglutition · Deglutition disorders

F. Tamura (✉) · T. Kikutani · T. Tohara
Rehabilitation Clinic for Speech and Swallowing Disorders,
The Nippon Dental University School of Life Dentistry at
Tokyo, Dental Hospital, 3-16, Fujimi 2-chome, Chiyoda-ku,
Tokyo 102-8158, Japan
e-mail: fumita@tokyo.ndu.ac.jp

T. Tohara
e-mail: takashitohara@qa2.so-net.ne.jp

T. Kikutani
Division of Clinical Oral Rehabilitation, The Nippon Dental
University Graduate School of Life Dentistry at Tokyo, 9–16,
Fujimi 1-chome, Chiyoda-ku, Tokyo 102-0071, Japan
e-mail: kikutani@tokyo.ndu.ac.jp

M. Yoshida
Dental Department, Hiroshima City General Rehabilitation
Center, Hiroshima, Japan

K. Yaegaki
Department of Hygiene, The Nippon Dental University School
of Life Dentistry at Tokyo, Tokyo, Japan
e-mail: yaegaki-k@tky.ndu.ac.jp

The tongue plays an important role in feeding and swallowing function. Feinberg et al. [1] reported that bolus misdirection due to dysfunction and abnormality was more frequent at the oral stage alone or at both the oral and pharyngeal stages than at the pharyngeal stage alone. Dysfunction and abnormality of the tongue might also be a reason for dysphagia, since problems at the oral stage are one of the reasons for dysphagia. Many elderly people under long-term care suffer from malnutrition caused by dysphagia and frequently develop sarcopenia because of malnutrition [2]. Sarcopenia is defined as loss of muscular mass, strength, and physical performance. Sarcopenia caused by aging is also affected by the levels of anabolic hormones, which may suppress appetite or lead to a reduction of protein synthesis, resulting in worsening of the condition [3, 4] and subsequent restriction of physical activities in the elderly.

Elderly people frequently suffer from eating malfunction and malnutrition [5, 6]. Fewer occluding pairs of teeth decrease chewing function and increase chewing difficulty [7]. Therefore, chewing ability may contribute to the regulation of nutritional status in the elderly, as reported

previously [8]. Subsequently, chewing ability is associated with not only oral health status but also with the physical constitution of the elderly [8]. Low tongue pressure reflects dysphagic tongue movement and cough [9]. Moreover, a decline of oral muscle strength as well as fewer occluding teeth may cause malfunction of feeding; therefore, we presume that malnutrition may worsen in dysphagic patients. Our hypothesis is that sarcopenia may occur in the tongue as well as in other tissues. In other words, we speculated that muscle volume may relate to tongue sarcopenia rather than to body size. If so, sarcopenia of the lingual muscles would compromise oral function in the elderly. Once atrophy of the tongue occurs, people may start to develop malnutrition because of dysphagia. In most cases, the meal texture of these people becomes softer, requiring less power of tongue movement. Consequently, tongue atrophy may be promoted. The objectives of this study were to evaluate sarcopenia of the lingual muscles by measuring the tongue thickness and to elucidate its relationship with nutritional status.

Subjects and Methods

We studied 104 elderly subjects (32 men and 72 women, mean age = 80.3 ± 7.9 years). All maintained occlusal support with either natural dentition or dentures. Neither paralysis nor atrophy of the tongue was observed. The anthropometric data of triceps skinfold thickness (TSF), midarm muscle area (AMA), body weight (BW), and height (HT) were measured to evaluate nutritional status [8, 10].

Anthropometric measurements were conducted as follows: Mid-upper-arm circumference (MAC) was measured on the left arm with a tape measure. TSF was measured with Harpenden Skinfold Calipers over the triceps muscle at the midway point between the acromion and the olecranon process. AMA was calculated from MAC and TSF values based on a previously reported formula [11]. The mean of the twice-repeated measurements was taken as the true value. Tongue thickness was measured using ultrasonography (Nemio 17, SSA-550A, Toshiba Medical Systems, Tokyo, Japan). A fixation device to retain a 3.75-MHz convex probe (contact face size = 12 × 70 mm) in an appropriate position was employed to obtain accurate images, as shown in Fig. 1. To assure stable image acquisition, the probe was firmly fixed to the subject's lower jaw by wrapping a belt around the head. The subjects were asked to remain seated in an upright position. They were also instructed to swallow their saliva often and to set the tongue at the resting position. Then, ultrasonic measurements were carried out.

The measurement points were determined on the upper and lower surfaces of the lingual muscles in the center of
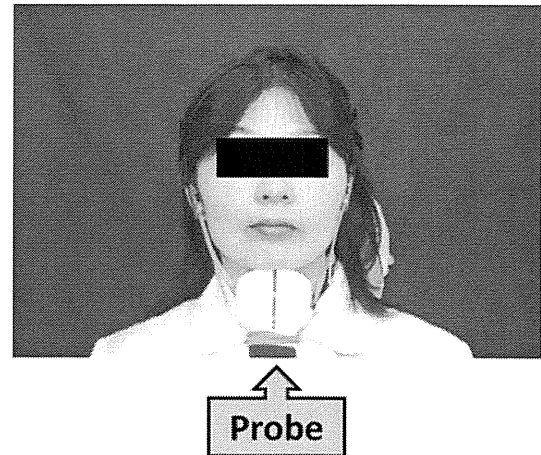

Fig. 1 Position of ultrasonic probe in frontal view

the plane perpendicular to the Frankfurt horizontal plane in a frontal section, as shown in Fig. 2 [12]. This perpendicular plane went through the distal surfaces of the mandibular second premolars on both sides. The measurement point on the coronal plane is shown in Fig. 3. The vertical distance was measured from the surface of the mylohyoid muscle to the tongue dorsum. Figure 4 shows an image of a frontal section of the tongue on ultrasonography. Measurements were performed twice in freeze-frame when the tongue was restored to the resting position after swallowing saliva, and the mean values were obtained. To determine the reliability of the tongue thickness measurement, the two-way mixed-effects model of the intraclass correlation coefficient (ICC) (1,2) was used. The ICC values were above 0.75, indicating good reliability; values of 0.9 and
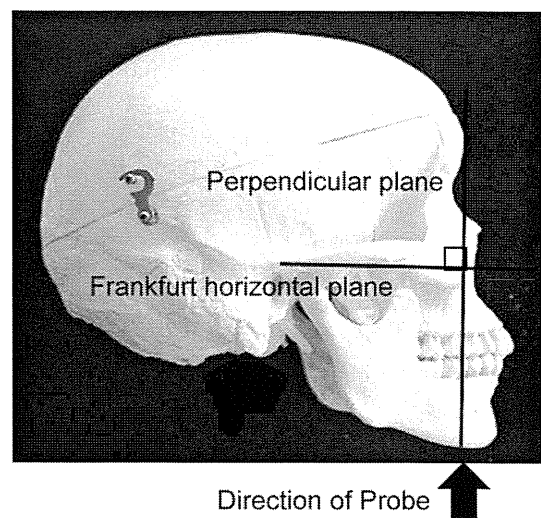

Fig. 2 Position of ultrasonic probe in lateral view. The measurement points were determined at the center of the plane perpendicular to the Frankfurt horizontal plane in a frontal section. The perpendicular plane passes through the distal surfaces of the mandibular second premolars on both sides

Fig. 3 Diagram of tongue. Measured thickness is the vertical distance from the surface of mylohyoid muscle to the tongue dorsum
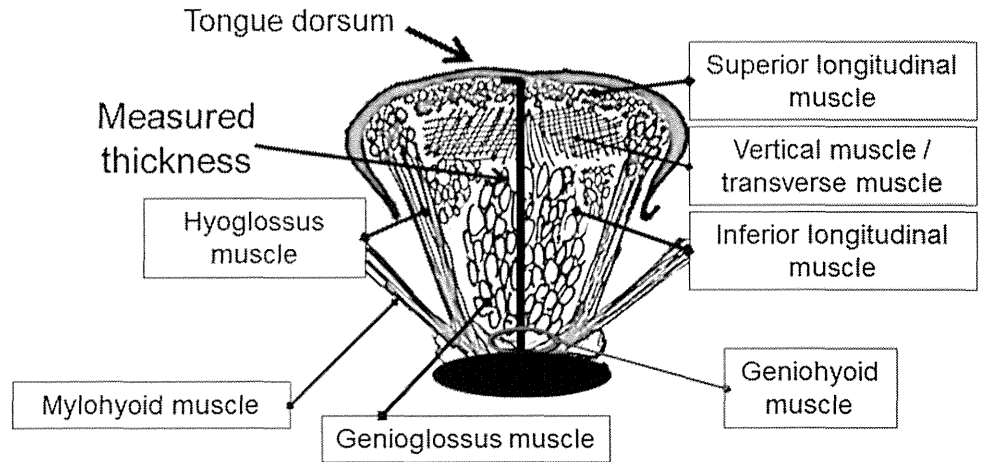
• Vertical distance from surface of mylohyoid muscle to tongue dorsum.
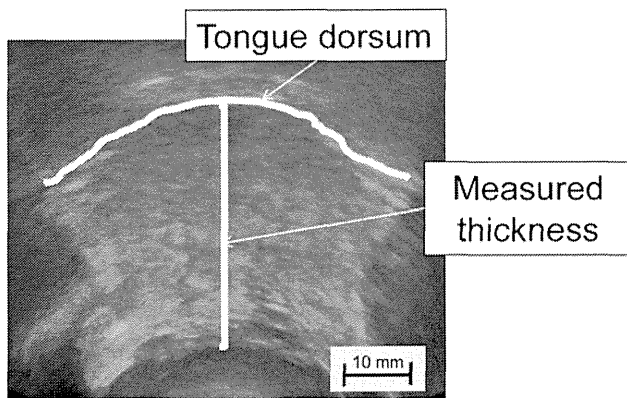
Fig. 4 Ultrasonographic image

above are reportedly even more reliable for ensuring the validity and reproducibility of clinical measurements [13]. The ICC (1,2) value for the intrarater reliability of tongue thickness measurement was 0.856 (95 % CI: 0.741–0.924).

The relationship between tongue thickness and nutritional status was analyzed using Pearson's correlation coefficient and Spearman's rank correlation coefficients using the software SPSS v16 (SPSS, Inc., Chicago, IL).

This study was approved by the Ethics Committee of The Nippon Dental University, School of Life Dentistry at Tokyo, Dental Hospital. Before starting measurements, the purpose and the protocol were explained to the subjects and/or their guardians in order to obtain their consent.

Results

Baseline Characteristics of Subjects

Table 1 gives the baseline characteristics of our subjects. TSF $= 11.4 \pm 4.6$ mm, AMA $= 34.9 \pm 7.6$ cm^2, HT $=$

Table 1 Baseline characteristics of subjects ($n = 104$)

	Mean	SD
Age (years)	80.3	7.9
TSF	11.4	4.6
AMA	34.9	7.6
Height (cm)	151.2	8.8
Body weight (kg)	48.9	8.8
Tongue thickness (mm)	46.9	5.5

TSF triceps skinfold thickness, *AMA* arm muscle area

151.2 ± 8.8 cm, BW $= 48.9 \pm 8.8$ kg, and tongue thickness $= 46.9 \pm 5.5$ mm.

Correlation Coefficients Between Tongue Thickness and Other Variables

Table 2 gives the correlation coefficients between tongue thickness and the other variables examined. Tongue thickness correlated with age ($r = -0.393$, $P < 0.001$), TSF ($r = 0.225$, $P < 0.05$), AMA ($r = 0.424$, $P < 0.001$), HT ($r = 0.312$, $P < 0.01$), and BW ($r = 0.434$, $P < 0.001$).

Table 2 Pearson's rank correlation coefficient between tongue thickness and other variables

Variables	Coefficient	P value
Age	−0.393	0.000
TSF	0.225	0.022
AMA	0.424	0.000
Height	0.312	0.001
Body weight	0.434	0.000

TSF triceps skinfold thickness, *AMA* arm muscle area

Table 3 Factors related to tongue thickness by stepwise multiple regression analysis

Variables	Beta	t	P value
AMA	0.231	3.412	0.001
Age	−0.188	−2.868	0.005

AMA arm muscle area

Model 1: Multiple correlation coefficient $(R) = 0.424$; adjusted coefficient of determination $(R^2) = 0.180$

Model 2: Multiple correlation coefficient $(R) = 0.492$; adjusted coefficient of determination $(R^2) = 0.227$

Stepwise Multiple Regression Analysis

Table 3 shows the results of a stepwise multiple regression analysis conducted to identify the factor most strongly influencing tongue thickness. The multiple correlation coefficient (R) was 0.492 and the adjusted coefficient of determination (R^2) was 0.227.

Discussion

Masticatory movement is governed by the coordinated functions of oral organs: teeth, jaw, cheek, lips, and tongue. Among them, the tongue plays an important role in mastication and swallowing since it transports food to the molars, initiates mastication, mixes foods with saliva, and propels a food bolus into the pharynx. Furthermore, the swallowing reflex occurs because the tongue and the soft palate close at the region of the fauces. Many elderly people under long-term care develop malnutrition because of a decline in masticatory and swallowing functions as described above. Improvement in swallowing is considered the most effective way to treat dysphagia because oral dysfunction is also strongly associated with dysphagia [1]. Therefore, evaluating tongue dysfunction or abnormality may be an essential diagnostic procedure for dysphagia. There are many methods for evaluating tongue function, i.e., measuring the strength [14–17] and speed and location of movement [18]. The strength of the tongue has been evaluated by measuring the maximum tongue pressure against the palate [14, 15]. There are some reports that tongue function in the elderly declines with age [14, 15, 19, 20]. However, the effects of malnutrition on tongue volume in the elderly are still unknown. In our study we used ultrasonography to measure tongue thickness. Ultrasonography is widely used for functional analysis of dysphagia and is also reported to be very practical for anatomical analysis [21]. Furthermore, ultrasonography has enormous potential for visualizing the tongue in clinical research because it is noninvasive and it is easy to perform repeated examinations.

The age-associated loss of both muscle mass and strength, termed sarcopenia, is highly relevant to nursing home residents [22]. It was reported that tongue sarcopenia was observed more frequently in aged rats than in control rats [23, 24]. However, the relationship between tongue sarcopenia and aging in humans is obscure. The absence of occlusal support affects tongue movement and oral function [14, 25, 26]. In this study we employed subjects with posterior occlusal dentition of their natural teeth or dentures to eliminate confounding variables.

It has been suggested that TSF and AMA correlate with nutritional status [8, 10]. TSF represents fat volume and AMA the muscle volume of the upper arm. Since there was a significant association between tongue thickness and nutritional status, tongue muscle volume may also be related to nutritional status.

Furthermore, it was suggested that sarcopenia may develop not only in skeletal muscles but also in the tongue. Hence, dysphagia, tongue disuse syndrome, or malnutrition may affect tongue thickness, with subsequent worsening of malnutrition. Moreover, Saito et al. [27] reported that in rats, the structures of tongue muscles (genioglossus and geniohyoid) may be affected by fat deposition in myofibers. Determination of the fat fraction may be required in our future studies on tongue sarcopenia [28].

It was suspected that tongue thickness correlates with mandibular length. In this regard, an animal study [29] showed the relationship between tongue thickness and mandibular length from infancy through childhood, whereas no such relationship was identified in a human study [30]. However, in the present study we demonstrated a significant relationship between tongue thickness and AMA (an index indicating muscle mass) and age by applying multiple regression analysis. Neither HT, a marker of bone in humans, nor BW (a similar marker) was found to correlate with tongue thickness, suggesting that general muscle volume and/or age alone may affect this feature of the tongue.

Atrophy of the tongue may not be the only reason for reduced tongue function and inability to maintain nutritional status. However, Kikutani et al. [31] reported that oral functional training to maintain and/or improve feeding function is very efficient for improving the nutritional condition. It was reported that muscle is replaced by fat or fibrous tissues with aging [32], implying that tongue exercise might restore muscle tissue. Robbins et al. [32] and Yeates et al. [33] also reported that exercising the tongue prevented general sarcopenia. Therefore, effective measures or protocols to prevent malnutrition, which involve tongue exercise or rehabilitation, may be necessary to improve tongue disuse syndrome. For this purpose, our method of monitoring tongue thickness by ultrasonography may provide information for a tongue exercise protocol or

treatment plan. We will study further the relationship between tongue pressure and tongue thickness in a future investigation.

Conclusion

The findings of this study suggest that tongue thickness is related to nutritional status in the elderly.

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Fumiyo Tamura   DDS, PhD

Takeshi Kikutani   DDS, PhD

Takashi Tohara   DDS

Mitsuyoshi Yoshida   DDS, PhD

Ken Yaegaki   DDS, PhD

ORIGINAL ARTICLE: EPIDEMIOLOGY,
CLINICAL PRACTICE AND HEALTH

National survey of the prevalence of swallowing difficulty and tube feeding use as well as implementation of swallowing evaluation in long-term care settings in Japan

Michiko Sugiyama,[1] Kento Takada,[1] Manami Shinde,[1] Nana Matsumoto,[6] Kazumi Tanaka,[2] Yumiko Kiriya,[3] Etsuko Nishimoto[4] and Masafumi Kuzuya[5]

[1]Department of Nutrition and Dietetics, Kanagawa University of Human Services, Yokosuka, Kanagawa, [2]Yamato City Health and Social Welfare, Yamato, Kanagawa, [3]Hatsudai Rehabilitation Hospital, Shibuya, Tokyo, [4]Hakuai Memorial Hospital, Tokushima, Tokushima, [5]Department of Community Health & Geriatrics, Nagoya University Graduate School of Medicine, Nagoya, Aichi, Japan; and [6]Sodexo South California, South California, California, USA

Aim: The present study was carried out to clarify tube feeding utilization and the prevalence of swallowing difficulty among residents in geriatric long-term settings, and to elucidate the implementation of swallowing assessment at four different types of facilities in Japan.

Methods: We mailed a questionnaire to a total of 4334 facilities.

Results: We received responses from 1137 (26.2%) facilities, including 440 (29.0%) from 1517 nursing homes, 275 (29.2%) from 941 long-term care facilities, 205 (18.1%) from 1134 sanatorium medical facilities and 217 (29.2%) from 742 rehabilitation hospitals. The number of tube-fed residents per 100 beds in each facility was 11.6 at the nursing homes, 7.4 at the long-term care facilities, 36.3 at the sanatorium medical facilities and 7.9 at the rehabilitation facilities. The number of residents per 100 beds with swallowing difficulty was 23.7 in the nursing homes, 15.6 in the long-term care facilities, 19.2 in the sanatorium medical facilities and 15.4 in the rehabilitation hospitals. The percentages of facilities that assessed swallowing difficulty were 31.8% of the nursing homes, 63.0% of the long-term care facilities, 77.9% of the sanatorium medical facilities and 91.7% of the rehabilitation hospitals.

Conclusion: A large number of residents using a feeding tube and with difficult swallowing were observed in geriatric long-term settings without adequate evaluation of swallowing function. **Geriatr Gerontol Int 2014; 14: 577–581.**

Keywords: long-term care facilities, swallowing difficulty, tube feeding.

Introduction

It is generally believed that a large percentage of geriatric residents have swallowing difficulties and/or nutritional problems. According to a 1996–1999 study of over 90% of randomly selected geriatric facilities in Japan, more than 40% of the residents were malnourished.[1] However, approximately 30% of the malnourished residents were able to improve their nutrition within 3 years.[1]

Numerous studies have shown that poor nutritional status as well as swallowing difficulty was strongly correlated with poor outcomes in the elderly, including hospital administration and mortality.[2–4] Swallowing difficulty might also lead geriatric residents/patients to undernutrition/dehydration and aspiration pneumonia. These comorbidities increase residents/patients risks for hospital admission and feeding tube placement. Tube feeding (including percutaneous endoscopic gastrostomy [PEG] tube feeding) has become the most widely used method for long-term enteral feeding of patients or residents with swallowing difficulty or inability to take sufficient food by mouth. However, reviews of the relevant literature have questioned the benefits of tube-feeding individuals with special conditions, such as advanced dementia.[5,6] Feeding tubes have not been found to improve survival, prevent aspiration

pneumonia, heal decubitus ulcers, or contribute to other important health outcomes.[5,6]

Relative to the clinical significance of swallowing difficulty and tube feeding use for older adults requiring care, reliable data to date has been lacking in Japan, a country with a sizable and growing older population. In addition, despite the impact of swallowing disorders in old age, available information on the implementation of swallowing evaluation has also been sparse. Under the circumstances, we carried out a national survey to investigate the prevalence of swallowing difficulty and tube-feeding use as well as implementation of swallowing evaluation in various long-term care settings.

Methods

Data collection

We randomly selected 4334 facilities according to facility size and region within Japan using randomized sampling of three subpopulations. The selected facilities included 1517 nursing homes, 941 long-term care facilities, 1134 sanatorium medical facilities and 742 rehabilitation hospitals. We excluded facilities with fewer than 30 residents. Full-time dietitians at the facilities were asked to complete the questionnaire. If none was present, a registered nurse or other medical staff completed the questionnaires. Completed questionnaires were mailed back to us from 1 September to 30 October 2009. Written informed consent for participation was obtained from the participants, dietitians/medical staff, or, for those with substantial cognitive impairment, from a surrogate (usually the closest relative or legal guardian) according to procedures approved by the institutional review board of Kanagawa University of Human Services.

Parameters

We collected data from the standardized questionnaires: a brief description of the facility (census, mean number of patients/residents, number of dietitians employed) and the demographic characteristics of the patients/residents currently admitted. Data were also obtained from the staff regarding the number of patients/residents who were using feeding tubes and who were potentially transitioning from tube feeding to oral intake, and patients/residents with swallowing problems. In addition, we also asked whether they were carrying out the swallowing evaluation of the patients/residents, and the assessment methods they used (water swallowing test, conventional checking sheet, modified water swallowing test, cervical auscultation, food test, repetitive saliva swallowing test, videofluoroscopic examination of swallowing, fiberoptic endoscopic examination of swallowing, ice chip swallowing test, ultrasonography, other physical diagnosis, others).

Terminology

The term "resident" used for the remainder of the present article will signify both residents of and patients at the geriatric-care facilities surveyed.
1 Tube-fed resident: A resident using a nasogastric tube or PEG tube with or without oral intake.
2 Resident who was potentially transitioning from tube feeding to oral intake: a resident using tube feeding who is hemodynamically stable, alert, lucid, has a positive swallowing reflex and does not choke when swallowing saliva.
3 Resident with swallowing difficulty: a resident with oral feeding who uses a thickened liquid diet, who chokes with meal intake, and has a current or past history of aspiration pneumonia and swallowing problems.

Statistical analysis

To compare the groups' facilities, we used the analysis of variance (one way ANOVA) test and χ^2-test (residual analysis) as appropriate. SPSS version 17.0 J for Windows (SPSS Japan 122, Tokyo, Japan) was used for the statistical analysis.

Results

The mean proportions of tube-fed patients/residents ranged from 7.4% to 36.3%, with the highest proportion found in patients admitted to sanatorium types of medical facilities. By contrast, only small numbers of residents (0.5–2.6) who were potentially transitioning to oral intake per 100 beds were observed in the various facilities. When we calculated the mean numbers of cases per 100 tube-fed patients/residents, 4.7–9.0 residents fulfilled these conditions, except for rehabilitation hospitals in which 37.6 per 100 tube-fed patients were potentially transitioning to oral intake. In addition, we also observed the high prevalence of swallowing difficulties with 15.4–23.7% among oral-fed residents (Table 1).

The implementation rate of swallowing evaluation varied from 31.8% in nursing homes to 91.7% in rehabilitation hospitals (Table 2). The various swallowing evaluation tests were used in geriatric facilities. Most of the nursing homes used clinical examinations, such as water swallowing tests. Instrumental examinations, more objective evaluation of swallowing, such as videofluoroscopic examination of swallowing and fiberoptic endoscopic evaluation of swallowing, were mainly used at rehabilitation hospitals, and not used at most of the nursing homes and long-term care facilities (Table 2).

Table 1 Facility demographics and numbers of residents who are tube-fed, transitioning to oral intake, or swallowing difficulties

		Nursing homes (n = 440)		Long-term care facilities (n = 275)		Sanatorium medical facilities (n = 204)		Rehabilitation hospitals (n = 217)		P*
		n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	
No. beds in the facility		439	70.9 (26.7)	274	91.6 (25.4)	198	81.6 (78.7)	210	63.8 (37.0)	<0.001
Mean age (years)		423	85.9 (1.9)	270	84.8 (2.0)	183	80.8 (3.8)	186	74.4 (4.8)	<0.001
No. tube-fed patients	per facility	440	7.8 (5.8)	275	6.7 (6.7)	204	32.1 (36.1)	217	5.3 (6.3)	<0.001
	per 100 beds	440	11.6 (8.5)	275	7.4 (7.0)	204	36.3 (22.7)	217	7.9 (7.4)	<0.001
No. patients who were potentially transitioning to oral intake	per 100 beds	437	0.5 (1.3)	275	0.6 (1.4)	200	1.5 (3.1)	213	2.6 (4.2)	<0.001
	per 100 tube-fed patients	408	4.7 (13.8)	237	9.0 (17.8)	195	4.8 (9.5)	184	37.6 (56.3)	<0.001
No. residents with swallowing difficulties among orally-fed residents	per facility	407	16.4 (13.2)	275	14.5 (14.1)	204	14.4 (24.1)	217	9.9 (12.7)	<0.001
	per 100 beds	406	23.7 (17.0)	274	15.6 (13.9)	203	19.2 (24.7)	213	15.4 (15.9)	<0.001

*P-values: one-way ANOVA.

Table 2 Implementation of assessment methods to address swallowing problems in elderly residents and patients

	Nursing homes (n = 440) n (%)ᵃ	r†	Long-term care facilities (n = 275) n (%)ᵇ	r†	Sanatorium medical facilities (n = 204) n (%)ᶜ	r†	Rehabilitation hospitals (n = 217) n (%)ᵈ	r†
Implementation of swallowing evaluation assessment method	127 (31.8)	−14.9**	162 (63.0)	0.9	148 (77.9)	5.6**	199 (91.7)	11.8**
Swallowing problem assessment method								
Water swallowing test	109 (24.8)	−12.7**	138 (50.2)	−1.6	109 (53.4)	6.4**	150 (69.1)	11.5**
Conventional [check sheet]	102 (23.2)	−10.9**	117 (42.5)	0.6	131 (64.2)	3.8**	171 (78.8)	9.1**
Modified water swallowing test	64 (14.5)	−16.2**	108 (39.3)	−2.1*	119 (58.3)	6.6**	184 (84.8)	15.4**
Cervical auscultation	57 (13.0)	−18.1**	91 (33.1)	−1.9	109 (53.4)	8.6**	177 (81.6)	16.5**
Food test	50 (11.4)	−9.4**	83 (30.2)	−3.5**	123 (60.3)	5.5**	177 (81.6)	10.6**
Repetitive saliva swallowing test	41 (9.3)	−15.2**	103 (37.5)	−3.4**	135 (66.2)	7.9**	195 (89.9)	15.1**
Videofluoroscopic examination of swallowing	29 (6.6)	−14.6**	38 (13.8)	−2.4*	81 (39.7)	5.8**	170 (78.3)	15.6**
Fiberoptic endoscopic examination of swallowing	22 (5.0)	−12.9**	17 (6.2)	−6.1**	27 (13.2)	4.7**	60 (27.6)	18.1**
Ice chip swallow test	15 (3.4)	−1.2	26 (9.5)	−2.2*	56 (27.5)	2.7**	83 (38.2)	1.4
Ultrasonography	8 (1.8)	−5.4**	2 (0.7)	−3.1**	10 (4.9)	1.4	8 (3.7)	9.0**
Other physical diagnosis	75 (17.0)	−3.4**	60 (21.8)	−0.2	44 (21.6)	2.1*	49 (22.6)	2.9**
Others	11 (2.5)	−3.3**	17 (6.2)	1.1	8 (3.9)	1.5	9 (4.1)	2.3*

χ^2-test (a vs b vs c vs d. †Standardized residual $|r| > 2.58$, $P < 0.01$; $|r| > 1.96$, $P < 0.05$). *$P < 0.05$, **$P < 0.01$ (residual analysis).

Discussion

The present data were not influenced by the region within Japan or the facility size. In the present study, we observed that the number of tube-fed residents per 100 beds in each facility was 11.6 at the nursing homes, 7.4 at the long-term care facilities, 36.3 at the sanatorium medical facilities and 7.9 at the rehabilitation facilities. The total numbers of beds (including facilities with fewer than 30 residents) for all of Japan were reported to be 432 900 in nursing homes, 308 233 in long-term care facilities, 332 986 in sanatorium medical facilities and 63 373 in rehabilitation hospitals. Based on these data, and the mean numbers of tube-fed residents per 100 beds from the present results, we estimated the number of tube-fed residents in Japan to be 50 216 in nursing homes, 22 809 in long-term care facilities, 120 874 in sanatorium medical facilities and 5006 in rehabilitation hospitals.

The prevalence of tube feeding among nursing home residents varies between countries and even among regions in one country. It has been reported that the prevalence of PEG tubes among nursing home residents with advanced cognitive impairment in the USA varies from 18% to 34% nationally,[7–10] with substantial within-state variation from 7.5% to 40%.[11] In Italy, an average of 6.6% of nursing home residents were tube fed.[12] A nationwide survey in Germany showed that 6.6% of nursing home residents received tube feeding.[13] A report from Taiwan showed that 29.2% of residents in long-term care facilities were fed by tube.[14] A large 2010 survey by the All Japan Hospital Association revealed that the prevalence of PEG feeding was 8.8%, 7.2% and 29.6% in nursing homes (data from 387 nursing homes), long-term care facilities (251 facilities), and sanatorium medical facilities (210 facilities), respectively. These results are similar to the results of the present study.

Only a limited number of studies of the prevalence of swallowing difficulty in individuals living in geriatric settings have been reported. In Taiwan, the prevalence rate for impaired swallowing was estimated to be 31.9% for non-tube-fed residents in long-term care facilities.[13] In nursing homes in Helsinki, Finland, 14.5% of the residents had swallowing difficulty.[14] We observed that the prevalence of swallowing difficulty among orally-fed participants at various geriatric settings ranged from 15.4% to 23.7%. We might have underestimated the number of residents with difficulty swallowing. This could be due to the low rate of swallow test implementation in the facilities. The residents with swallowing difficulty seem to have a high risk of not only life-threatening events, such as aspiration pneumonia and suffocation, but also feeding-tube placement without the appropriate interventions.

To our knowledge, no other studies so far with large sample sizes have determined the number of older residents who are potentially transitioning from tube feeding to oral intake together with the numbers of orally-fed residents with difficulty swallowing in long-term care settings. The present study identified fewer residents who were potentially transitioning from tube feeding to oral intake in nursing homes and long-term care facilities where high levels of care are required, because residents in those facilities are less likely to meet the four criteria established by the study (hemodynamically stable, arousal without stimulation, positive swallowing reflex and does not choke when swallowing saliva). Again, we might have underestimated the number of these residents because of the low rate of swallow test implementation in the facilities.

In fact, we found that just 31.8% of the nursing homes that responded to the present survey carried out swallow evaluations, although there were many residents with swallowing difficulty in the facilities. In addition, only a few nursing homes used videofluoroscopic examination of swallowing or fiberoptic endoscopic evaluation for the swallow test. It is possible that many nursing homes do not have access to facilities that provide such evaluations. The lack of the adequate evaluations of swallowing abilities of the nursing home residents could reduce the chances of transitioning from tube feeding to oral intake and maintaining oral intake, and facilitate tube insertion as means of feeding.

The present study had potential limitations. First, the recovery rate for the questionnaire was fairly low; and second, there could be a participation bias for institutions with a special interest in nutritional care. Third, we surveyed the prevalence of total tube feeding, and did not distinguish PEG tube feeding and other feeding tube methods, such as a nasogastric feeding tube. The strength of the present study was that our data were not influenced by the region within Japan or the facility size, as we randomly selected facilities according to facility size and region within Japan.

In conclusion, we found that a relatively large number of residents with feeding tube use and with difficult swallowing among orally-fed residents were observed in geriatric long-term settings. In addition, we also showed that a limited swallowing evaluation of the residents, especially among nursing homes, is common, suggesting that many of the residents have life-threatening events risks without appropriate evaluations of the swallowing ability, and that there are residents who lose the chance of transitioning from tube feeding to oral intake, or who lead to feeding tube placement because of the lack of adequate swallowing evaluations and interventions. A swallowing evaluation system should be implemented, and efforts should be made to improve patient swallowing capabilities so that adequate nutrition –

and thus improved health – are maintained in elderly patients at long-term care facilities.

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Disclosure statement

The authors declare no conflict of interest.

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原著論文

介護保険施設における認知症高齢者の
食事中の徴候・症状に対する栄養ケアの有効性

田中 和美 [1),5)]，高田 健人 [2)]，大矢 未帆子 [3)]，杉山 みち子 [4)]，川久保 清 [5)]

【抄録】　本研究では，介護保険施設入所者の栄養ケア・マネジメント（Nutrition Care and Management：以下 NCM）において，認知症高齢者の食事中の徴候・症状別に対する栄養ケアの有効性を検証することを目的にした。11項目の認知症高齢者の食事中の徴候・症状に対する NCM を行った介入群108名と，通常のNCM を行った対照群36名の BMI，食事摂取量（主食，副菜，全体の喫食%），認知症高齢者の食事中の徴候・症状の頻度（5段階）を1か月毎に3か月間モニタリングを実施し，有効性を検証した。

介入群の【拒食】【傾眠】【徘徊・多動】の頻度は，3か月後に軽減が見られた。介入群の食事摂取量は，全体，主食，副菜ともに，3か月の全期間にわたって増大がみられ，特に介入後1か月後に増大がみられた。BMIは1カ月後に増大がみられた。対照群では，認知症高齢者の食事中の徴候・症状の頻度の軽減は見られず，食事摂取量も増加しなかった。

以上の結果から栄養ケアの介入は，一部の認知症高齢者の食事中の徴候・症状の頻度の軽減と，認知症高齢者の低栄養状態の改善に有効であることが明らかになった。

キーワード：認知症高齢者の食事中の徴候・症状，低栄養状態，介入研究，栄養ケア・マネジメント，介護保険施設入居者

I．緒　言

我が国の 2010年における 65歳以上人口割合は約23％であるが，2035年には約34％となり，特に75歳以上の後期高齢者人口は 2035年にはピークの445万人になると推測されている [1)]。認知症の有病率は75歳以上では年齢が5歳増えるごとにほぼ倍増するため [2)]，後期高齢者人口が急増する我が国においては，今後認知症高齢者が著しく増加すると予想されている [3)]。

厚生労働省の高齢者介護研究会による報告書「2015年の高齢者介護：高齢者の尊厳を支えるケアの確立に向けて」では，主要な高齢者介護の課題の1つとして「新しいケアモデルの確立：認知症高齢者ケア」が位置づけられ [4)]，2006年4月施行の改正介護保険法では目的規定に「尊厳の保持」が規定された。現在我が国ではこの理念の下，増大する認知症高齢者に対し，認知症ケアの質を向上させるために，パーソン・センタード・ケア [5)6)]等，認知症高齢者の個性を重視するさまざまなケアが取り組まれている。

介護保険施設に入所している認知症高齢者においては，個人の尊厳，安定した生活や本人の生活の質（Quality of Life：以下 QOL）を阻害する大きな要因の1つとして，精神症状と行動障害（Behavioral and Psychological Symptoms of Dementia：以下 BPSD）があげられる。中でも認知症の中核症状から現れる食事中の徴候・症状及び BPSD（以下認知症高齢者の食事中の徴候・症状）は，自立摂取困難等，摂食行動に影響し，介護者の負担を増し，食事量の減少や体重減少による低栄養状態や身体の合併症を引き起こす原因となる [7)]。

認知症高齢者の食事中の徴候・症状と低栄養状態との関連については，筆者らが行った認知症高齢者の食事中の徴候・症状の研究 [8)9)]より，認知症高齢者の食事中の徴候・症状（食事の失認，傾眠，興奮・大声・暴言・暴力，妄想，拒食，偏食，徘徊・多動，早食い・詰め込み・丸呑み，失行（手づかみ食べ），異食，盗食）は，ほぼ日常的に出現し，食事摂取量の低下等の低栄養状態との関連があることが明らかにされている。

しかしながら，認知症高齢者の食事中の徴候・症状をアセスメントし，有効な栄養ケアを実施することに