

denture" group (PD, n=671, 27.1%) and the "complete denture" group (CD, n=187, 6.8%), which wore dentures in both jaws, were selected for analysis from the subjects as a whole (Fig. 1).

Acceptance of each food was significantly different ($p<0.01$) among the three kinds of dental status (Fig. 2-a, b, c). Masticatory ability was impaired for individuals wearing complete or partial dentures, compared with having natural dentition (Fig. 3). Only 11.8% of

the CD group reported that they could eat all three foods without difficulty (group 1), compared with 30.0% of the PD group or 80.0% of the dentate group.

Diseases with higher prevalence were gastrointestinal disease (31.3%), skeletal disease (28.6%) and hypertension (27.1%). There were significant differences in the prevalence of cardiovascular disease, diabetes and osteoporosis among the three kinds of dental status (Fig. 4). Cardiovascular disease, diabetes and

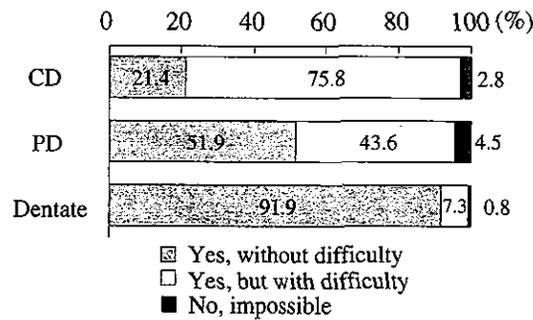


Fig. 2-a Relationship between chewing an apple and dental status

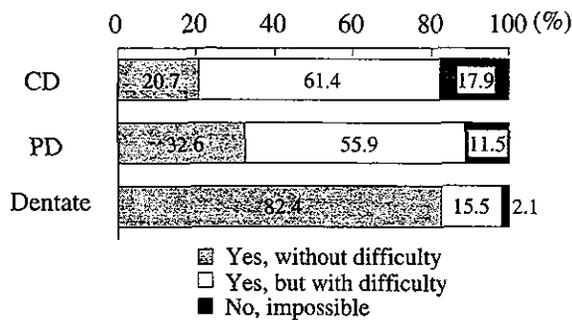


Fig. 2-b Relationship between chewing a hard rice cracker and dental status

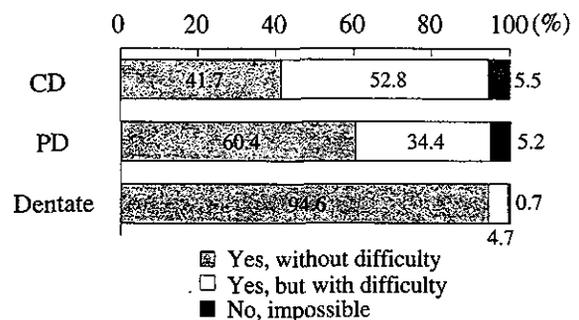


Fig. 2-c Relationship between chewing baked beef and dental status

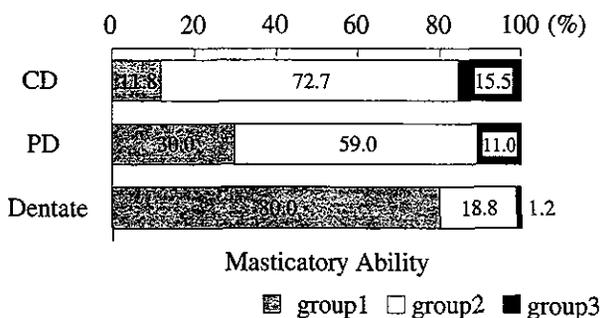


Fig. 3 Relationship between masticatory ability and dental status

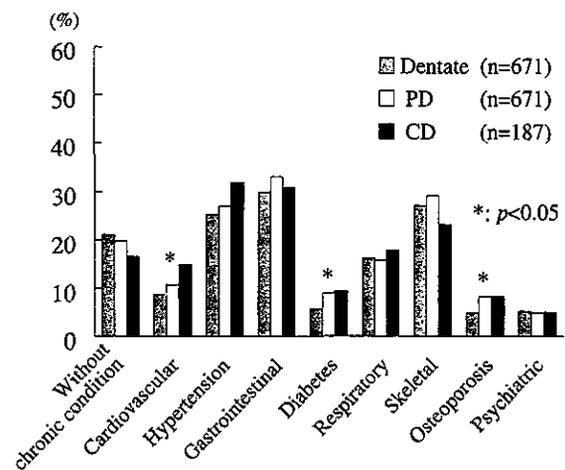


Fig. 4 Dental status and general diseases
Statistical significance was evaluated by chi-square tests of independence.

osteoporosis showed a significant lower prevalence in the dentate group than the CD or PD groups.

The prevalence of persons without a chronic health condition was likely to be higher in the well mastication group (group 1) in any kind of dental status (Fig. 5-a, b, c). On the other hand, the prevalence of gastrointestinal disease was significantly higher in the impaired mastication group (group 3) in any kind of dental status.

DISCUSSION

This study evaluated a specific population who was living in an urban area and who volunteered for an education program. Therefore, this study population was assumed to be comparatively healthier, better-educated, and more well-to-do than the average older

Japanese. However, in Japan, most elderly people are functionally independent and have no limitations in their daily activities. Therefore, it is important to know about the oral health of these independent elderly people who appear to represent a majority of the elderly Japanese population.

Educational and income levels may be important variables for our study. But in Japan, to ask questions about educational or income level, especially to old people, is impolite and may result in a refusal to participate in the study. Therefore, we did not use these questions in our questionnaire.

There are several laboratory tests of masticatory performance, but most of them are time-consuming, and none is ideal for investigating large populations (Osterberg *et al.*²²). Therefore, we used the responses to simple questions for self-assessed masticatory per-

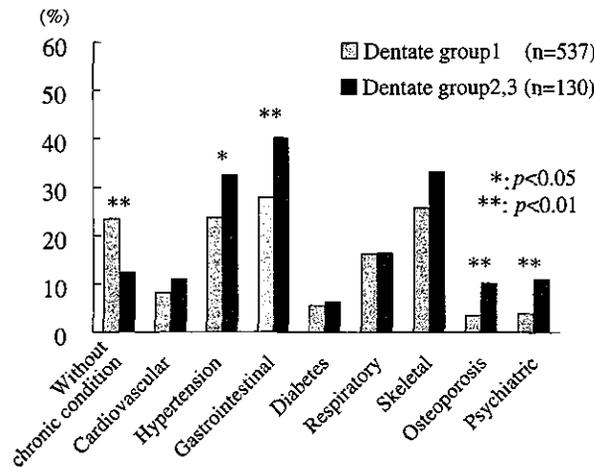


Fig. 5-a Masticatory ability and general diseases in dentate subjects
Statistical significance was evaluated by chi-square tests of independence.

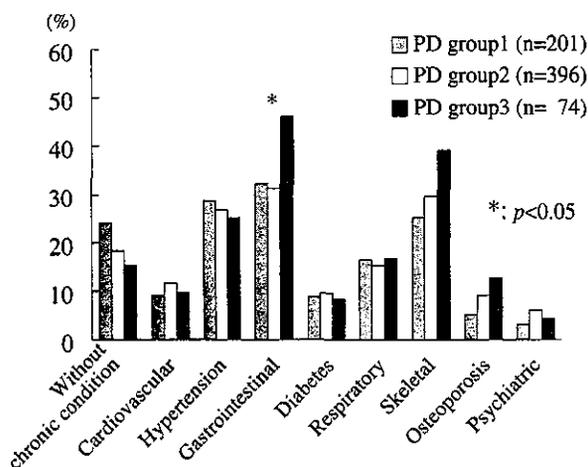


Fig. 5-b Masticatory ability and general diseases in removable partial denture wearers

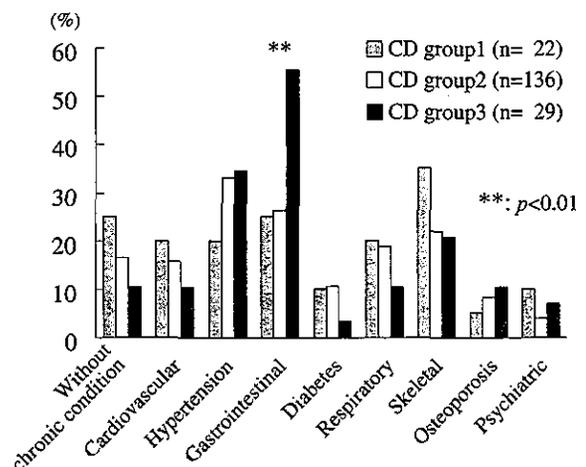


Fig. 5-c Masticatory ability and general diseases in complete denture wearers

formance to provide further information on chewing ability.

Previous reports have suggested that impaired masticatory ability leads to inadequate food choice, alters nutrient intake and therefore results in a chronic health condition (N'Gom, P. and Woda²⁴). Data from 8,300 adults showed that adults with a masticatory handicap in the low socioeconomic group have significantly lower intakes of calories and certain nutrients than the non-handicapped, although masticatory handicap appears to have little effect on nutrient intake in the high socioeconomic group (Chen and Lowenstein¹⁴). In a survey of 12,901 people, prevalence of reported impairment of chewing ability increased with aging, and edentulous people reported the highest prevalence of impaired masticatory ability, while dentate people reported the lowest. Relative risks for impaired masticatory ability, independent of age, gender and dental state, were higher for people with low income and living alone, as well as for those with skeletal, gastrointestinal, and psychiatric diseases (Osterberg *et al.*²²). In a study of 367 non-institutionalized individuals aged 60 years and over, 28% were taking some medication for gastrointestinal disorders. Lower intakes of fruits and vegetables were observed in subjects with poor masticatory performance. Furthermore, subjects with poor masticatory performance took significantly more drugs (37%) than those with superior performance (20%) (Brodeur *et al.*²⁵).

The present study agreed with the previous studies. Acceptance of each food and masticatory ability were associated significantly with dental status. While dental status by itself was not associated with gastrointestinal disease, self-assessed chewing ability was associated with gastrointestinal disease in any kind of dental status.

When insufficiently masticated, food is released whole or incompletely digested into the gastrointestinal tract. Gastritis and ulcers have been reported in subjects with impaired masticatory function (Carlsson²⁶). It is suggested that impaired masticatory ability leads to inadequate food choice and reduced consumption of high fiber foods, which could induce the development of gastrointestinal disorders (Brodeur *et al.*²⁵).

On the other hand, cardiovascular disease, diabetes and osteoporosis were less prevalent in the dentate group than the CD or PD groups. A possible reason is aging, since those diseases are well known to increase with age, along with the loss of teeth.

A link between a poor masticatory ability and gastrointestinal diseases, although not scientifically established, has been suggested. People should be encouraged to keep their natural teeth as long as possible because healthy natural teeth enable good masticatory performance which is better than artificial teeth. All

health care providers and public health policy officials should be aware of the association of masticatory ability with gastrointestinal disease even in independently living older adults. Dentists have to make an effort to provide appropriate dentures for their patients, and physicians have to consider the possibility of a masticatory disorder for patients with gastrointestinal disease. In addition, dietary intake of denture wearers should be monitored by a dietitian to prevent nutritional deficiency.

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原著論文

実験用口蓋床が厚さの弁別能に及ぼす影響

—材質および厚さによる変化—

古谷 暢子 吉仲 正記 小野 高裕 野首 孝祠

Influence of an Experimental Palatal Plate on
Discriminative Ability for Thickness

—Evaluation of Material and Thickness—

Furuya Masako, Yoshinaka Masaki, Ono Takahiro and Nokubi Takashi

歯科補綴学的意義

義歯を装着することによって、咀嚼機能および顔の外観は回復されるが、硬口蓋を被覆することは口腔感覚に与える影響が大きいと考えられる。硬口蓋の被覆が厚さの弁別能に与える影響について検討した結果、床によって硬口蓋を被覆すると厚さの弁別能は悪くなるが、床を薄くすることによって非装着時に近づくことが示された。すなわち、義歯床の厚さを薄くすることが可能な金属床の選択が有効であることが示唆された。

抄 録

目的：本研究の目的は、硬口蓋を被覆することが厚さの弁別能にどのような影響を与えるかを検討することである。

方法：習慣的な喫煙経験がなく、歯の欠損が認められない10名（男性6名、女性4名、平均年齢 24.7 ± 2.2 歳）を被験者として用いた。まず実験Iでは、実験床の材質による影響について検討した。実験用口蓋床として、硬口蓋を被覆する厚さ1.5mmのレジン床と金属床を製作した。各床装着時の厚さの弁別閾値は、厚さ3mmを基準片とし、0.2mmずつ薄くなる下降系列と0.2mmずつ厚くなる上昇系列の、厚さのみが異なる9段階の比較片を測定した。次に実験IIでは、実験床の厚さによる影響について検討した。厚さ1.5mmと厚さ0.5mmの2種類の実験床を製作し、各床装着時と非装着時において、実験Iと同様に厚さの弁別閾値を測定した。

結果：レジン床装着時と金属床装着時では、上昇系列および下降系列のいずれにおいても厚さの弁別能に有意差は認められなかった。床の厚さを変化させた場合、下降系列においては、1.5mm床装着時は非装着時と比較して有意に弁別能は悪くなり、0.5mm床装着時は1.5mm床装着時と比較して、有意に弁別能は良くなる傾向を示した。

結論：厚さを薄くすることが可能である金属床の選択は、口腔感覚の点から考えて有用であることが示唆された。

和文キーワード

厚さの弁別能, 口腔感覚, 官能検査

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I. 緒 言

義歯装着の目的として咀嚼機能および顔の外観の回復や残存組織の保護がある¹⁾が、人工臓器として機能するまでにはさまざまな義歯への不満が患者から訴えられる。たとえば、“気持ちが悪い”、“話しにくい”さらに“食べ物が味気ない”などがあげられるが、義歯装着によって口腔環境が変化したために、さまざまな口腔感覚に影響を及ぼしたものと考えられる²⁾。これまで著者らは、口腔感覚の1つである味覚に注目して、義歯装着後に生じる味覚の変化の原因には、味蕾が床に直接被覆されることだけではなく、咀嚼運動に変化が生じ味蕾に味物質が到達しにくくなることや心理的な要因が関与していることを報告してきた³⁻⁷⁾。一方、味覚は視覚、嗅覚さらにほかの口腔感覚が統合されて認識されるもの⁸⁾であり、義歯床が口腔粘膜を被覆することによって生じる触覚や温度覚の変化の影響も受けるものと考えられる。しかし、義歯の装着が口腔感覚にどのような影響を与えるかについての報告はほとんどない。

そこで本研究では、義歯床による口蓋粘膜の被覆が弁別能に与える影響を知ることが目的として、有歯顎者を対象に硬口蓋部を被覆する実験用口蓋床（以下、実験床とする）を製作し、厚さの弁別能について比較検討を行った。

なお、本研究については大阪大学大学院歯学研究科倫理委員会の承認を得ており、各被験者には本実験の要旨について説明を行い、了解を得た。

II. 方 法

1. 口蓋を被覆する床の材質による影響（実験Ⅰ）

1) 被験者

被験者には、大阪大学歯学部職員ならびに学生のなかから第三大臼歯以外に欠損を認めず、習慣的な喫煙経験のない24～28歳の10名（男性6名、女性4名、平均年齢 24.7 ± 2.2 歳）を採用した。

2) 実験床

各被験者の上顎に対しシリコーン印象材を用いて印象採得を行ったのち、超硬石膏（サンロック、デンツプライ三金）にて石膏模型を製作した。複模型用シリ

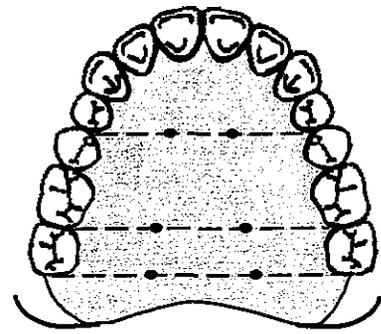


図1 The simulated figure of the experimental palatal plates and the measuring point (●) for thickness
各実験床の模式図と厚さの測定点（図中の●印）

コーン印象材（デュプリコーン、松風）と高温鑄造用耐火模型材（CD インベストメント、松風）を用いて耐火模型を製作し、周縁を口蓋側歯頸部、後縁をアーラインに設定し、Co-Cr合金（コバルタン、松風）を用いて厚さ1.5mmの金属口蓋床（以下、金属床とする）を製作した。さらに石膏模型にパラフィンワックス（厚さ：1.5mm）を用いて、金属床と同じ形態のワックスパターン製作後、注入型レジン（ポアレジン、松風）を用いて、厚さ1.5mmのレジン口蓋床（以下、レジン床とする）を製作した。いずれの実験床も研磨後、ホワイトシリコーン（フィットチェッカー、ジーシー）にて適合状態を確認したのち、咬合干渉が生じないように修正し実験床を完成した。さらに、各実験床の厚さは、図1に示した通り松田⁹⁾の報告に従い、第一小臼歯、第一大臼歯および第二大臼歯遠心を結ぶ線分をそれぞれ3等分した2点の計6点の測定点において、それぞれ1.5mmであることを確認した。

3) 被験試料

被験試料は、図2に示した通り注入型レジンを用いて、底面1辺5mmの正方形、厚さ3mmを基準片とし、0.2mmずつ薄くなる下降系列と0.2mmずつ厚くなる上昇系列の、厚さのみが異なる9段階の比較片を製作した。

4) 実験方法

各試料の厚さの判断は、視覚による影響をなくすために被験者にアイマスクを着用させ、また、指の感覚の影響をなくすために、スプーンに入れた試料を被験

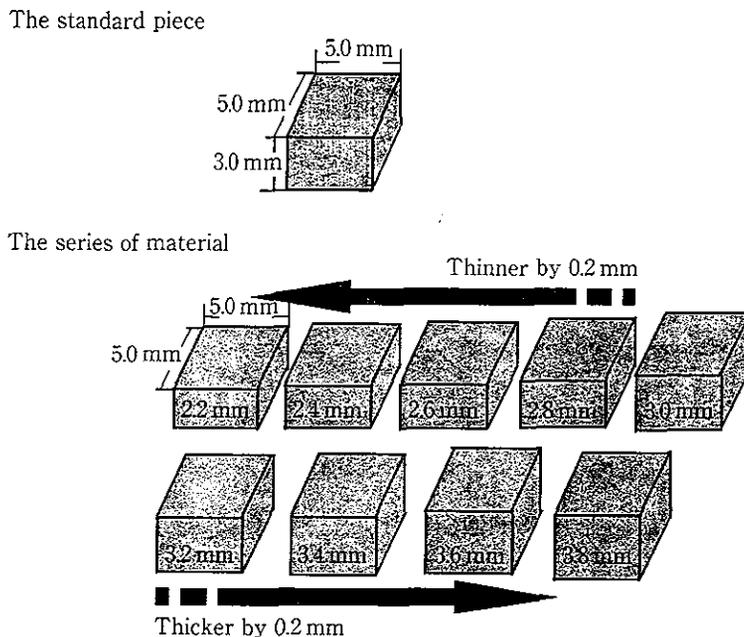


図2 The material used for this experiment
本実験に使用した被験試料

者自身が口腔内に入れ、舌と硬口蓋にはさんで行った。基準片と比較片を順次渡し、それぞれ3秒間で口腔外に出し、どちらが厚いかを答えさせた。各条件で9段階の比較片について10回ずつランダム検査を行い、堀尾らの報告¹⁰⁾から、10回正しく答えると有意な差があるとし、厚さの弁別が可能であると判断した。これを金属床装着時とレジン床装着時について行った。

5) 分析項目および分析方法

上昇系列と下降系列における各弁別閾値の差の検定には、Wilcoxon検定を用い、有意水準5%にて各条件間の統計学的検定を行った。

2. 口蓋を被覆する床の厚さによる影響(実験II)

1) 被験者

被験者には、実験Iで用いた被験者と同様の条件で24~28歳の17名(男性9名、女性8名、平均年齢 25.1 ± 2.8 歳)を採用した。

2) 実験床

実験床は、実験Iで用いたレジン床(以下、1.5 mm床とする)と、金属床の厚さのみを0.5 mmに変更した床(以下、0.5 mm床とする)の2種類を製作した。そのほか、実験床の製作は実験Iと同様に行った。

3) 被験試料ならびに実験方法

非装着時、1.5 mm床装着時および0.5 mm床装着時について、実験Iと同様に被験試料を用いて実験を行った。

4) 分析項目および分析方法

上昇系列と下降系列の各弁別閾値について、各条件における弁別閾値の差の検定には、有意水準5%にてKruskal-Wallis検定を用い、有意差の認められた場合に対して多重比較を行った。

III. 結果

1. 口蓋を被覆する床の材質による影響(実験I)

図3に示した通り、上昇系列と下降系列のいずれにおいてもレジン床と金属床との間で有意差は認められなかった。

2. 口蓋を被覆する床の厚さによる影響(実験II)

実験結果は図4に示した通りである。上昇系列においては、非装着時と比較して各実験床装着時の弁別閾値は高い値を示しているが、各条件間において有意差は認められなかった。一方、下降系列において、1.5 mm床装着時では、非装着時と比較して有意に弁別閾値が高くなった。また、0.5 mm床装着時では、非装

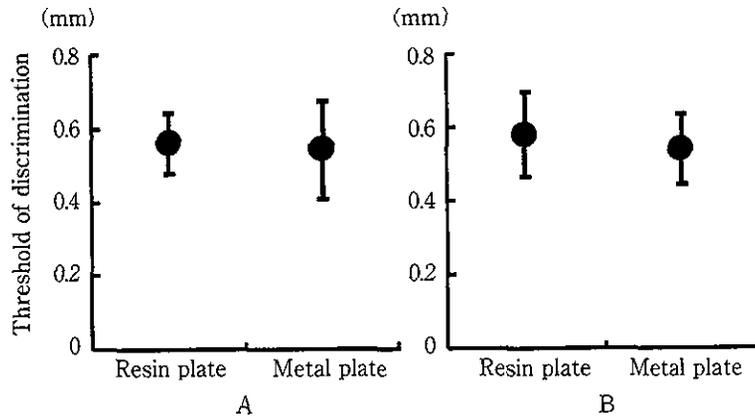


図3 The threshold of discrimination with the resin plate and the metal plate (n=10)
 (A : Compared with a series of thicker materials, B : Compared with a series of thinner materials)
 レジン床装着時および金属床装着時における厚さの弁別閾値 (n=10)
 (A : 上昇系列, B : 下降系列)

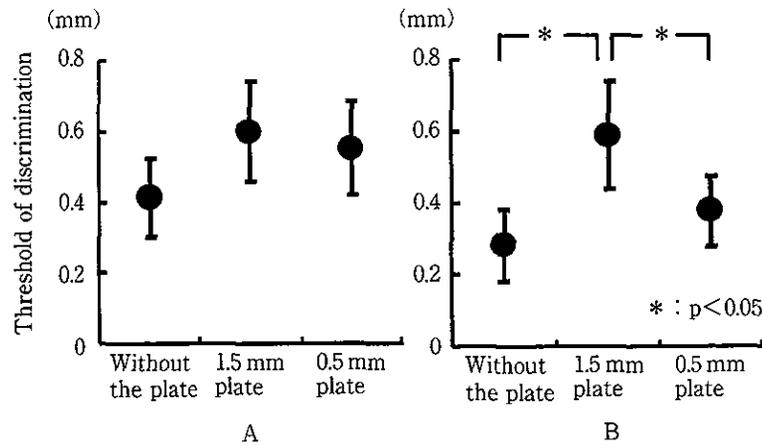


図4 The threshold of discrimination without the plate and with 1.5 mm plate and 0.5 mm plate (n=17)
 (A : Compared with a series of thicker materials, B : Compared with a series of thinner materials)
 非装着時, 1.5 mm 床装着時および0.5 mm 床装着時における厚さの弁別閾値 (n=17)
 (A : 上昇系列, B : 下降系列)

着時と比較して有意差は認められなかったが, 1.5 mm 床装着時と比較して有意に低い値を示した。すなわち, 床によって硬口蓋を被覆すると厚さの弁別能は悪くなるが, 床の厚さを薄くすることによって弁別能は回復することが示された。

IV. 考 察

一般に硬口蓋部には感覚点が多く存在しており, 食物の認識, 食塊の形成, 嚥下にいたる一連の咀嚼運動を行ううえで重要な部位である。また, 関塚²⁾は, 口蓋部を被覆するような義歯床, 連結装置あるいは支台装置などを装着することによって口腔内の感覚が変化

することを、榎村¹¹⁾は口蓋部の被覆によって咀嚼能率は低下し、舌と口蓋との運動や感覚機能の協調作用がうまく行われなくなることを報告している。一方、口蓋部連結装置の設定位置やその形態は、力学的に影響を与える¹²⁾だけではなく、感覚的²⁾にも音声学的¹³⁾にも影響を及ぼすことが報告されているが、厚さの弁別能に対する影響については明らかにされていない。このことから、本研究では硬口蓋部を被覆する床の材質や被覆する床の厚さの違いが、厚さの弁別能にどのように影響を及ぼすかについて検討し、その結果について考察を行う。

1. 実験方法について

1) 実験床

実験床の形態は、咀嚼および発音機能などに影響を及ぼすといわれている¹⁴⁾ことから、床縁の設定位置や厚さを規定する必要がある。これまで著者らが用いてきた床、すなわち、厚さは1.5 mm、周縁は咬合接触に影響を与えないように歯頸部に対し移行的に接し、後縁は全部床義歯の床後縁として多く利用されているアーラインに設定した床を基準とした。実験Iでは、材質による違いを検討するためにレジン床と金属床の2種類で比較した。実験Iにおいて材質による違いが認められなかったという結果から、実験IIでは厚さによる違いを検討するために、使用する材質は異なるが一般的に臨床でよく用いられるものとして、厚さ0.5 mmの金属床と厚さ1.5 mmのレジン床を用いた。

2) 厚さの弁別閾値

咀嚼筋の活動は高位中枢からの支配を受ける一方で、口腔内の感覚によって複雑な反射的調節を受けている¹⁵⁾ことから、口腔感覚は咀嚼運動を円滑に行ううえで重要な因子の1つであると考えられる。口腔感覚のうち厚さの弁別能に対する実験は、これまで多数報告されている¹⁶⁻²¹⁾。しかし、これらの弁別能の試験は、歯もしくは人工歯で被験試料を咬むことによって、その厚さの違いを判別するといった方法を選択しているが、実際に食物の形態やテクスチャーを認識する場合には、舌と歯(もしくは人工歯)、舌と硬口蓋および舌と頬粘膜によっても識別している²²⁾。硬口蓋を被覆するような義歯を装着した場合において、舌と硬口蓋による厚さの弁別能は変化するものと考えられる。したがって、本研究では被験者に実験床を装着

し、その材質や厚さによって弁別能に及ぼす影響を検討した。厚さの弁別能は基準の厚さが異なれば弁別閾値も変化するが、基準片の厚さを3 mmと10 mmの両方で検討した結果、試料が薄い場合は識別能力が高くなり、厚さの弁別に及ぼすテクスチャーの影響が少なくなるとの報告¹⁰⁾があるため、本研究では基準片の厚さを3 mmとした。そのほか実験方法については堀尾らの報告¹⁰⁾を参考とした。

被験者に関して、一般に生体は、発育、成長、老化という一連の過程を経ており、その間さまざまな形態的および機能的な変化が起こっている^{23,24)}。口腔感覚も例外ではなく、舌の振動や触覚の閾値は老人のほうが高くなる²⁵⁾。また、喫煙については味覚閾値が高くなるとの報告²⁶⁾もある。そのため、本研究の被験者は喫煙習慣が過去においても認められず、比較的口腔感覚の安定している20歳代の男女を選択した。

2. 実験結果について

1) 口蓋を被覆する床の材質による影響(実験I)

基準試料より薄い試料と比較する下降系列と、厚い試料と比較する上昇系列いずれにおいても、口蓋を被覆する床の材質による差は認められなかった。これは舌と口蓋による厚さの弁別には、パチニー小体を除くマイスナー小体、メルケル触覚板などの感覚受容器や筋紡錘が関与している²⁷⁾が、口蓋を被覆する床の厚さが同じであれば、床の材質が異なっても弁別能には変化を与えなかったものと考えられる。

2) 口蓋を被覆する床の厚さによる影響(実験II)

下降系列では、非装着時と比較して1.5 mm床装着時では有意に弁別閾値は高くなり、また、1.5 mm床装着時と比較して、0.5 mm床装着時は有意に弁別閾値は低くなった。これは、実験床が硬口蓋部の感覚受容器を被覆すると、その部分からの情報が変化したため厚さの弁別能が低下するが、実験床を薄くするとより非装着時に近い状態で検査を行うことになるため、厚さの弁別能も回復したものと考えられる。しかし、上昇系列では、非装着時、1.5 mm床装着時および0.5 mm床装着時の弁別閾値に有意差は認められなかった。上昇系列と下降系列で結果が異なったことについて、森本²⁸⁾は、大きさの弁別能について開口量が小さく5秒以内にテストした場合、基準より厚いほうが薄いものより判別が困難となり、方向特異性が認め

られたと報告している。本実験においても、非装着時では上昇系列の弁別閾値は 0.41 ± 0.11 mm, 下降系列の弁別閾値は 0.28 ± 0.10 mmとなっており, 方向特異性が認められている。これは, 基準片を口腔外に出した直後に比較片を口腔内に入れたこと, 被験試料の厚さは最大でも3.8 mmであり開口量が少なかったことから, 筋紡錘中の一次終末からの情報の影響を受けたものと考えられる。本実験では, 上昇系列における厚さの弁別能力が下降系列ほど高くないため, 各条件における弁別閾値の傾向は下降系列と同様であるが, 有意差が認められなかったものと考えられる。

V. 結 論

本研究は, 硬口蓋を被覆する床の厚さが異なることによって, 舌と口蓋の間で行う厚さ識別にどのような影響を及ぼすかを検討するため, 厚さのみ異なる2種類の実験床を用い, 厚さ弁別能検査を行った結果, 以下のような結論を得た。

1. 厚さ1.5 mmの実験床装着時においては, その材質によって厚さの弁別能に有意差は認められなかった。

2. 厚さ3 mmを基準として, 0.2 mmずつ厚くなる上昇系列においては, 硬口蓋を被覆することや被覆する床の厚さの違いによって弁別能に有意差は認められなかった。

3. 厚さ3 mmを基準として, 0.2 mmずつ薄くなる下降系列においては, 1.5 mm床装着時は非装着時と比較して有意に弁別能は悪くなり, 0.5 mm床装着時は1.5 mm床装着時と比較して有意に弁別能はよくなる傾向を示した。

以上の結果, 義歯床が硬口蓋を被覆すると厚さの弁別能は悪くなるが, 床を薄くすることによって非装着時に近づくことが示され, 床を薄くすることが可能な金属床の選択は, 口腔感覚を阻害しにくいという点で有効であることが示唆された。

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Influence of an Experimental Palatal Plate on Discriminative Ability for Thickness

—Evaluation of Material and Thickness—

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ABSTRACT

Purpose : The purpose of this research was to examine if covering of the hard palate has an influence on oral sense.

Materials and Methods : In this study, the following experiments were performed on 10 normal subjects with intact dentition, who were nonsmokers. The first experiment was performed to find the influence according to kinds of material constituting an experimental plate. Two kinds of experimental plates covering on the whole hard palate were made : a "Resin plate" and a "Metal plate" (thickness of both plates, 1.5 mm). After producing each palatal plate, the test of discriminative ability for the thickness was performed with "Resin plate" and "Metal plate". Material that was 3 mm thick was used as the standard, and it was compared with a series of material that were thicker and thinner by 0.2 mm increments. The second experiment was performed to find the influence according to the thickness of an experimental plate. Two kinds of experimental plates were made, "1.5 mm plate" and "0.5 mm plate". Testing of discriminative ability for thickness was performed at three conditions : the "1.5 mm plate", the "0.5 mm plate", and no plate.

Results : 1. When wearing "Resin plate" and "Metal plate", there was no significant difference in discriminative ability for the thickness. 2. When 3 mm-thick material was used as the standard and compared with a series of successive, 0.2 mm-thinner materials, there was a significant difference in discriminative ability for the thickness with no plate and with "1.5 mm plate" and "0.5 mm plate".

Conclusions : These results suggested that it is effective to choose metal plate that is possible to make thickness thin, in terms of the oral sense. It is possible to make thickness thin.

Key words

discriminative ability for thickness, oral sense, sensory test

Application of short-form oral health impact profile on elderly Japanese

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Application of short-form oral health impact profile on elderly Japanese

Objectives: The purpose of this study was to use the oral health impact profile (OHIP-14) to evaluate the impact of oral disease on the quality of life of a group of independently-living elderly persons in an urban area of Japan.

Subjects: A total of 1244 participants of the Senior Citizen's College, who attended the lectures once a week. They were community-dwelling, independently-living people over 60 years of age.

Measurements: Japanese version of the short-form OHIP-14.

Results: Internal reliability for the 14 items overall was very high (Cronbach's $\alpha = 0.95$). Report of 'painful aching' and 'uncomfortable to eat' were the two most highly scored items using the mean sum OHIP-14 score. A multiple logistic regression analysis indicated that the sum OHIP-14 score had significant associations with self-assessment of general health, dental status, and a perceived need for dental treatment. However, age, gender, dissatisfaction with financial status or education level was not significantly associated with the sum OHIP-14. Compared with that of other countries, the items were ranked similarly, whereas the perceived magnitudes of the problems were quite different from other population.

Conclusions: The OHIP-14 in Japanese had a high internal reliability, was significantly associated with dental status and comparable ranking for items when compared with studies from other countries.

Keywords: quality of life, oral health impact profile, OHIP, dental status, international comparison.

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Introduction

Since World War II, economic growth in Japan has led to improved public health and medical services, which have increased life expectancy of the Japanese population. As a result, the proportion of older people during the past few decades has increased, accelerated by a decrease in the birth rate¹. In the year 2002, Japan's average life expectancy reached 78.4 years for males and 85.3 years for females, which is the highest in the world. The disability-adjusted life expectancy, the so-called 'healthy life expectancy' of the Japanese, is 75.0 years and is also the highest in the world². In Japan, most old people (95.5% of those 75–79 years, 90.8% of those 80–84 years, and 79.1% of those 85 years and over) are functionally independent and have no limitations in their daily activities¹.

The extension of people's lifespan and the enhancement of their quality of life are two central goals of health care systems, as reflected in policies developed by the World Health Organisation. Quality of life is an important outcome of dental care. The majority of dental care strives to restore and maintain oral comfort, function and aesthetics and rarely involves the treatment of life-threatening diseases. Therefore information regarding the impact of dental status and treatment on the quality of life is a recognised need³. Traditional measures of oral health ignore the perceptions and feeling of the person and the effect of their mouth on them⁴.

The oral health impact profile (OHIP), developed in Australia, is an instrument designed to measure oral-health-related quality of life⁵, and has been used in several populations^{6,7}. The short-form

OHIP-14 was developed as a modified version of OHIP and is reported to have good reliability, validity and precision⁸. OHIP-14 has been reported to be a useful instrument for use in a clinical setting⁹.

In view of the culturally specific nature of peoples' perceptions of health, it is important to compare oral-health-related quality of life among countries. The use of health measures in different linguistic and socio-cultural environments raises questions about cultural orientation and values reflected in these measures⁷. Most researches on cross-cultural equivalency of health status measures have been conducted with English-language scales and indices. Allison *et al.* compared item weights of the OHIP of an Australian sample with a sample of English-speaking Canadians and another with French-speaking Canadians and found that although items were ranked similarly, the perceived magnitude of problems were quite different⁷. Most OHIP study populations have been from western countries.

The purpose of this study was to use the OHIP-14 to evaluate the impact of oral disease on the quality of life of a group of independently-living elderly persons in an urban area of Japan.

Methods

The initial study population were all of the registered students (1454 persons) of the Senior Citizens' College of Osaka Prefecture, who attended the program in 2001. The study sample consisted of community-dwelling, independently living people over 60 years of age who attended the lectures once a week. Data were collected during July 2001. Excluding absent students and non-respondents, 1244 participants returned the questionnaires, which was 85.6% of the initial study population.

The purpose of the study and its procedures were described to the subjects and informed consent was obtained before distributing a questionnaire. The study protocol was reviewed and approved by the relevant institutional boards of Osaka University Graduate School of Dentistry. The subjects were given the opportunity to ask questions while completing the questionnaire and were informed that they had the right to refuse to answer any particular question. The questionnaires were identified numerically to protect the privacy of the participants.

The original OHIP consisted of 49 questions or items organised into seven sub-domains of impact: functional limitation, physical pain, psychological discomfort, physical disability, psychological

disability, social disability, and handicap. Slade and Spencer have fully described development of the OHIP instalment and its preliminary evaluation⁵. Briefly, the items were derived from content analysis of interviews with patients with a variety of oral disorders and then grouped into sub-domains to reflect a conceptual model of disease and disease consequences previously proposed by Locker¹⁰.

The short-form OHIP-14 was developed by Slade⁸ because research in a clinical setting often has time limitations, which does not permit the use of the original OHIP. The OHIP-14 instrument is useful for quantifying levels of impact on well-being in a setting where only a limited number of questions can be used. The OHIP-14 includes two question items from each of the impact sub-domains (Table 1). These domains are organised to reflect the hierarchy of increasingly complex and disruptive impacts or problems. The first three domains – functional limitations, physical pain and psychological discomfort – include items that have impact primarily limited to the individual's experience, whereas items in the disability and handicap domains represent impacts or problems that may alter everyday activities and social roles^{6,8}. Each question asks, 'During the last year, how often have the following occurred because of problems with your mouth or teeth?' Response options are 'very often', 'fairly often', 'occasionally', 'hardly ever', and 'never.'

The OHIP-14 was translated into Japanese to develop a version which was appropriate for the local population. It was administered according to the procedures recommended by Guillemin *et al.*¹¹. The translation process involved the forward translation from English into Japanese by three bilingual individuals whose first language was Japanese and then the backward translation from Japanese into English by another three bilingual individuals whose first language was English. All translators worked independently and were not associated with the research in any other way. Furthermore, the back translators did not have access to the original English version.

Once these forward and backward translations were completed, careful word-by-word comparisons of the original and the back translations of both English and Japanese versions were made. The three Japanese translators finalised the Japanese version before pilot-testing a Japanese-speaking sample, after which further modifications were made.

In addition to the OHIP-14 questionnaire, subjects completed a self-administered questionnaire which requested information about age, gender,

Table 1 Questions of oral health impact profile (OHIP)-14.

During the last year, how often have the following occurred?

0 = never, 1 = hardly ever, 2 = occasionally, 3 = fairly often, 4 = very often

1 Functional limitation

- (a) Have you had trouble *pronouncing any words* because of problems with your teeth, mouth or dentures?
 (b) Have you felt that *your sense of taste* has worsened because of problems with your teeth, mouth or dentures?

2 Physical pain

- (a) Have you had *painful aching* in your mouth?
 (b) Have you found it *uncomfortable to eat any foods* because of problems with your teeth, mouth or dentures?

3 Psychological discomfort

- (a) Have you been *self-conscious* because of your teeth, mouth or dentures?
 (b) Have you felt *tense* because of problems with your teeth, mouth or dentures?

4 Physical disability

- (a) Has your *diet been unsatisfactory* because of problems with your teeth, mouth or dentures?
 (b) Have you had to *interrupt meals* because of problems with your teeth, mouth or dentures?

5 Psychological disability

- (a) Have you found it *difficult to relax* because of problems with your teeth, mouth or dentures?
 (b) Have you been a bit *embarrassed* because of problems with your teeth, mouth or dentures?

6 Social disability

- (a) Have you been a bit *irritable* with other people because of problems with your teeth, mouth or dentures?
 (b) Have you had *difficulty doing your usual jobs* because of problems with your teeth, mouth or dentures?

7 Handicap

- (a) Have you felt that life in general was *less satisfying* because of problems with your teeth, mouth or dentures?
 (b) Have you been *totally unable to function* because of problems with your teeth, mouth or dentures?

self-assessed general health, domicile, employment, satisfaction with financial status, educational level, dental status (complete denture, removable partial denture, or natural dentition), and perceived need for dental treatments.

Statistical analysis

Typically weighting of a self-assessment research item is carried out to allow the relative severity or importance of the events described by scale items to be incorporated into scale scores. Weighting items has the potential to increase a scale's validity and predictive ability. However, calculating weighted scores is more complex, time-consuming and can introduce errors that are not introduced when all items are considered to be of equal significance. Although reports of the use of weighting of the OHIP items did demonstrate a slight improvement in the performance of the OHIP, it was determined that the simple scoring methods were comparable and therefore preferable to more sophisticated ones¹². Thus, a simple non-weighted scoring method was used in this study.

The OHIP-14 scores were calculated in two ways¹². The first method was a simple counting of the number of items to which a subject responded 'fairly often' or 'very often'. This reduced the response scale to a dichotomy and provided the

number of functional and psychosocial impacts experienced on a yearly level. This method was termed the simple-count method (OHIP-14 SC). The second method was to sum the numeric response codes (0 for 'never', 1 for 'hardly ever', 2 for 'occasionally', 3 for 'fairly often', and 4 for 'very often') for all 14 items producing a single summative score for each respondent⁷. This method incorporated the full range of impact responses, irrespective of their frequency. The summary score was called the sum OHIP-14. Internal consistency was assessed using Cronbach's reliability coefficient α based on single summary score between two items in the same dimension and among all 14 items.

The OHIP-14 SC and sum OHIP-14 were compared with demographic and dental variables as well as to previous reports from other populations^{5,6,8}. Statistical analyses included descriptive analyses, the Mann-Whitney *U*-test, the Kruskal-Wallis test and a logistic regression analysis using SPSS version 11.0.

Multiple logistic regression analysis was used to identify variables independently associated with the sum OHIP-14. This dependent variable was dichotomised comparing the proportion of subjects with a sum OHIP-14 of 11 or more to subjects with 10 or less using the median split as described in a study by Locker *et al.*¹³. The independent variables

were age, gender, self-assessed general health, spouse, living alone, employment, financial status, education level, dental status, and perceived need for dental treatment. Initially, all independent variables were forced into the logistic regression model. Secondly, independent variables were entered into the model by the forward stepwise method. In the final model, only determinants that were statistically significant at $p < 0.05$ were included by the forward stepwise method. Beta coefficient, standard error, p -values, odds ratio, and 95% confidence intervals were estimated.

Results

Subjects who left a response for any question blank were excluded from this analysis ($n = 302$). The number of completed questionnaires was 942, or 75.7% of the total sample. The mean age of the subjects was 67.1 ± 4.4 years, and 59.4% were male.

Internal consistency for the individual questions using Cronbach's α for seven of the domains ranged from 0.68 to 0.86, indicating good reliability for those dimensions (Table 2). Internal reliability for the 14 items overall was very high ($\alpha = 0.95$)⁷.

The mean of the OHIP-14 SC was 0.44 ± 1.42 (SD), although the distribution ranged from 0 to 14 and was highly skewed (Fig. 1). Only 16.2% of the subjects reported at least one oral health impact (fairly often or very often) over the last year.

The percentages of the non-responders for each question ranged from 3.1% (taste worse) to 5.5% (difficulty doing jobs). The individual's OHIP scores of the excluded sample were compared with the reported sample. No significant difference was found between the both groups in any 14 items. Consequently, we believe non-respondents were

Table 2 Internal consistency of the Japanese version OHIP-14 ($n = 942$).

Domain	Consistency (Cronbach's coefficient α)
Functional limitation	0.73
Physical pain	0.68
Psychological discomfort	0.82
Physical disability	0.84
Psychological disability	0.81
Social disability	0.85
Handicap	0.86
Overall 14 questions	0.95

Internal consistency was assessed using Cronbach's reliability coefficient α based on single summary score.

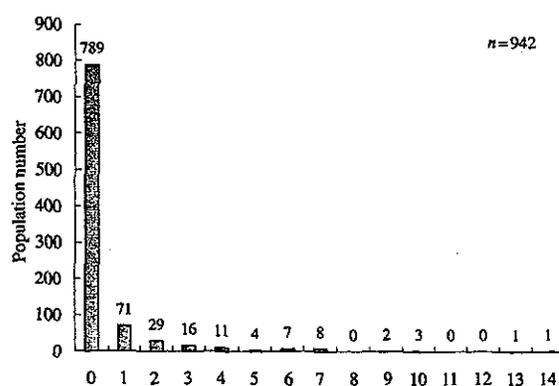


Figure 1 Distribution of OHIP-14 SC (fairly often or very often).

not significantly biased and should not affect the main focus of this study.

The percentage of persons reporting an oral health impact for each item ranged from 8.1% (uncomfortable to eat, 2-b) to 0.5% (difficulty doing jobs, 6-b and unable to function, 7-b) (Table 3). The most prevalent items were those in the sub-domain of physical pain (2-a,b) and psychological discomfort (3-a,b), while items in the social disability sub-domain (6-a,b) and being unable to function (7-b) were reported by <1% of the respondents.

The mean of the sum OHIP-14 was 10.93 ± 8.79 (SD), although the distribution of the sum OHIP ranged from 0 to 48 and was not normal (Fig. 2). The mean of the individual OHIP scores for each item ranged from 1.23 (painful aching, 2-a) to 0.51 (irritable with others, 6-a) (Table 3). Report of 'painful aching' and 'uncomfortable to eat' (2-a,b) in the physical pain sub-domain were the two most highly scored items using the mean sum OHIP-14 score. The next most highly scored items were 'diet unsatisfactory' (4-a) and 'tense' (3-b) from the physical disability and the psychological discomfort sub-domains respectively. The four most frequently reported items having an impact on quality of life represented three subdomains, which were physical pain, psychological discomfort and physical disability. The four items reported to occur most frequently in the last year as measured by the OHIP-SC were physical pain, psychological discomfort, and functional limitation sub-domains. The domains of social disability (6-a,b) and handicap (7-a,b) were reported least frequently by both scoring methods.

Bivariate analyses

Subjects with a poor self-assessment of general health, dissatisfied with their financial status,

Table 3 Summary of the simple count and single summary item scores for OHIP-14 from Osaka (n = 942).

Domains	Items	OHIP-SC ^a		Individual's OHIP score ^b		Non-responder	
		%	Rank	Mean (SD)	Rank		
1a	Functional limitation	Trouble pronouncing words	4.4	6	0.70 (0.79)	9	4.3
1b		Taste worse	4.5	4	0.74 (0.78)	8	3.1
2a	Physical pain	Painful aching	4.5	4	1.23 (0.77)	1	3.3
2b		Uncomfortable to eat	8.1	1	1.14 (0.95)	2	4.1
3a	Psychological discomfort	Self-conscious	5.2	2	0.83 (0.88)	5	4.6
3b		Tense	4.9	3	0.95 (0.81)	4	4.4
4a	Physical disability	Diet unsatisfactory	3.9	7	0.97 (0.73)	3	4.2
4b		Interrupt meals	1.4	10	0.66 (0.52)	10	4.7
5a	Psychological disability	Difficult to relax	2.1	8	0.82 (0.63)	6	4.6
5b		Been embarrassed	2.1	8	0.74 (0.64)	7	5.0
6a	Social disability	Irritable with others	0.7	12	0.51 (0.42)	14	5.1
6b		Difficulty doing jobs	0.5	13	0.54 (0.43)	12	5.5
7a	Handicap	Life unsatisfying	1.2	11	0.60 (0.48)	11	5.3
7b		Unable to function	0.5	13	0.52 (0.40)	13	5.4

^aThe OHIP-SC indicates the proportion of persons who responded 'fairly often or very often'.

^bThe individual's OHIP score is the mean of the codes: 0 = never, 1 = hardly ever, 2 = occasionally, 3 = fairly often, and 4 = very often).

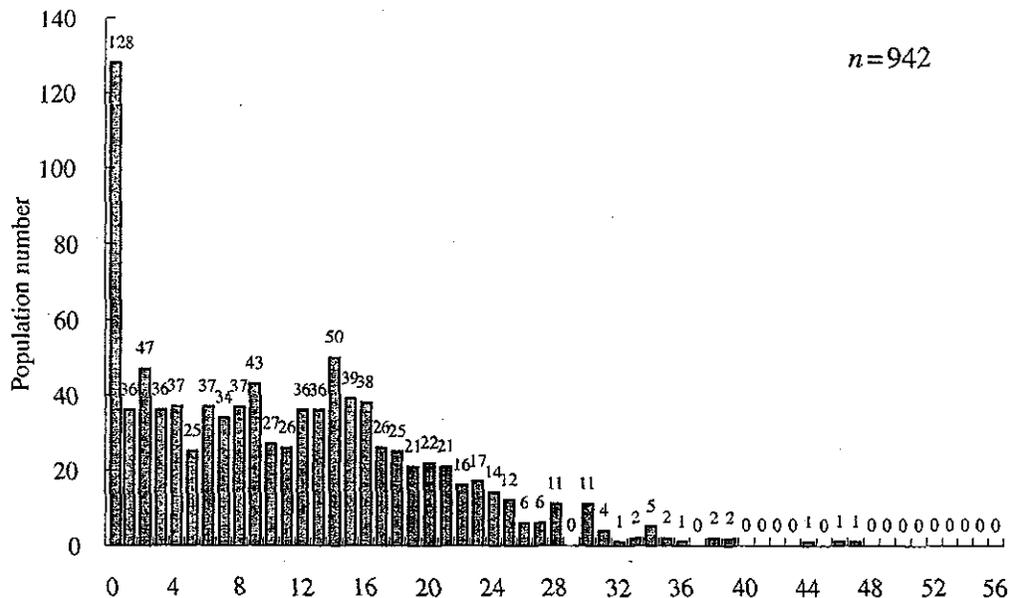


Figure 2 Distribution of sum OHIP-14.

without a college education, with a removable denture, and with a perceived need for dental treatment, had significantly higher mean scores of OHIP-14 SC. This suggests that they had a frequency of oral impacts compared with their peers (Table 4). There were no significant differences in the mean OHIP-14 SC scores by age, gender,

marital status, living status or employment status ($p < 0.05$). The bivariate analyses using the sum of OHIP-14 measure found associations with self-assessment of general health, financial status, education level, dental status, and a perceived need for dental treatment which was very similar to the results of the OHIP-14SC scores (Table 4).

Table 4 Mean and standard deviation of OHIP-14 SC and sum OHIP-14 for the 60+ Japanese in Osaka.

	n ^a	OHIP-14 SC		sum OHIP-14	
		Mean (SD)	p-value ^b	Mean (SD)	p-value
Total	942	0.44 (1.42)		10.93 (8.79)	
Age					
60–69 years	673	0.44 (1.39)	ns	10.85 (8.82)	ns
70+ years	265	0.46 (1.51)		11.23 (8.75)	
Gender					
Male	560	0.39 (1.34)	ns	10.63 (8.67)	ns
Female	382	0.52 (1.52)		11.37 (8.95)	
Self-assessed general health					
Good/fair	817	0.38 (1.30)	<0.001	10.55 (8.56)	<0.001
Poor	77	1.16 (2.33)		16.53 (9.85)	
Spouse					
With spouse	742	0.42 (1.41)	ns	10.99 (8.77)	ns
Without spouse	200	0.50 (1.44)		10.73 (8.89)	
Living alone					
With family	825	0.43 (1.41)	ns	10.98 (8.81)	ns
Alone	117	0.48 (1.48)		10.61 (8.68)	
Employment					
Working	175	0.47 (1.60)	ns	10.74 (8.96)	ns
Retired	766	0.43 (1.38)		10.99 (8.75)	
Financial status					
Satisfied/fair	857	0.39 (1.32)	0.001	10.72 (8.61)	0.021
Dissatisfied	85	0.93 (2.14)		13.04 (10.25)	
Education level					
High school or less	596	0.51 (1.58)	0.038	11.41 (9.06)	0.028
College, University	346	0.32 (1.08)		10.11 (8.25)	
Dental status					
Natural dentition	536	0.16 (0.72)	<0.001	7.36 (7.08)	<0.001
Removable partial denture	304	0.61 (1.55)		15.17 (7.93)	
Complete denture	102	1.41 (2.72)		17.10 (10.25)	
Perceived need for dental treatment					
Yes	525	0.66 (1.75)	<0.001	13.11 (9.20)	<0.001
No	375	0.09 (0.45)		7.70 (7.00)	

ns, not significant.

^aMay not add to 942 because of missing values.

^bMann–Whitney test, $\alpha = 0.05$. OHIP-14 scores were calculated in two ways. The first consisted of a count of number of items to which a subject responded 'fairly often or very often'. This method was termed the simple-count method and made OHIP-14 SC. The second summed the response codes for 14 items to produce single summary score for individual. This was called the sum OHIP-14.

Multivariate analyses

Multivariate analyses allows for the assessment of the independent contribution of each factor while adjusting for the effect of other variables in the model. Results from the multiple logistic regression analysis indicated that measures of oral and general health were significantly related to the dichotomised sum of OHIP-14 scores whereas the sociodemographic variables were not. Table 5-a summarises the logistic model with all independent variables forced into the model and Table 5-b shows the final

model as a result of the stepwise forward selection method. Comparison of the models shows that the non-significant associations in the forced entry method did not approach significance at $\alpha = 0.1$. The variables significantly associated with higher level of oral health impacts or problems were very significant at $p < 0.001$. As shown in Table 5-b, those who assess their general health as 'poor' were almost four times more likely to report more problems or impacts when compared with those persons who assessed their general health as 'good or fair' (OR: 3.96, 95% CI: 2.19–7.18). Respondents

Table 5 Logistic regression analysis for sum OHIP-14 ($n = 942$).

Independent variables	β	SE	<i>p</i> -value	Odds ratio	95% CI for OR	
(a) Using forced entry method						
Age	0.081	0.173	0.641	1.08	0.77	1.52
Gender	-0.033	0.184	0.856	0.97	0.67	1.39
Self-assessed general health	1.363	0.306	<0.000	3.91	2.15	7.12
Spouse	-0.492	0.300	0.101	0.61	0.34	1.10
Living alone	0.182	0.357	0.610	1.20	0.60	2.42
Employment	-0.195	0.197	0.322	0.82	0.56	1.21
Financial status	0.126	0.274	0.646	1.13	0.66	1.94
Education level	0.181	0.169	0.286	1.20	0.86	1.67
Dental status	1.860	0.162	<0.000	6.43	4.68	8.82
Perceived need for dental treatment	0.738	0.157	<0.000	2.09	1.54	2.84
(b) Using forward stepwise method						
Self-assessed general health	1.377	0.303	<0.000	3.96	2.19	7.18
Dental status	1.832	0.159	<0.000	6.25	4.58	8.53
Perceived need for dental treatment	0.739	0.157	<0.000	2.09	1.54	2.85

Dependent variable – sum OHIP-14 score: 0–10 = 0, 11+ = 1, dichotomised using median splits.

Independent variables – age: 60–69 years = 0, 70+ years = 1; gender: male = 0, female = 1; self-assessed general health: good/fair = 0, poor = 1; spouse: with spouse = 0, without spouse = 1; living alone: with family = 0, alone = 1; employment: working = 0, retired = 1; financial status: satisfied/fair = 0, dissatisfied = 1; education level: college, university = 0, high school or less = 1; dental status: natural dentition = 0, with removable denture = 1; perceived need for dental treatment: no = 0, yes = 1.

with a removable denture were over six times more likely to report more impacts than respondents who had a natural dentition (OR: 6.25, 95% CI: 4.58–8.53). The Japanese elders who had a perceived need for dental treatment were about two times more likely to report more oral health impacts or problems as those who did not report a treatment need (OR: 2.09, 95% CI: 1.54–2.85).

Discussion

Researchers who do not have a suitable health-related quality of life instrument available in their own language have two choices: (a) to develop a new measure, or (b) to modify a measure previously validated in another language, known as a cross-cultural adaptation process¹¹. The latter is more feasible in an international collaboration. Therefore, a Japanese version of the short-form OHIP-14 was developed.

While OHIP was intended to provide comprehensive data about the perception of well-being, our research setting was not suitable for using the full 49-item OHIP instrument. Therefore, we adapted the short-form OHIP-14, for which reliability, validity and precision also has been established⁸.

The Japanese version OHIP-14 performed well with regards to reliability because of the very high Cronbach's α value (0.95) for seven of the domains, suggesting that it is a useful instrument for meas-

uring oral-health-related quality of life and that OHIP has international value.

Our study population might be considered healthier and better educated than the average older adult in Japan in that more of our subjects had finished high school (89%) and more had at least a college degree (37%). This is a higher level than the average in the national survey, which reported that 52% had finished high school and 10% had a college degree¹⁴. Data from other studies indicate that higher impacts are reported by elders with less education¹⁵, therefore our results are likely to underestimate the impact of oral health among the general elderly population in Japan.

It was interesting that the sum of the OHIP-14 scores for items such as 'painful aching' and 'diet unsatisfactory' were ranked higher than were those same items using the OHIP-14 SC when the responses 'fairly often' and 'very often' were combined. Our findings show a higher percentage of responses of 'occasionally', suggesting a moderate impact for these two questions among our Japanese elders.

The sum of OHIP-14 was significantly associated with self-assessed general health, dental status and perceived need for dental treatment at both the bivariate and multivariate level of analyses. However, neither dissatisfaction with financial status nor education level was significantly associated

with the sum OHIP-14. It should be considered that financial dissatisfaction and lower education could be related to other variables remaining in the logistic model thus contributing to their lack of significance independently. With regard to financial status, the majority of these elders were middle class or higher. Japan has a national health insurance system for all citizens that includes dental care. These facts may have contributed to the lack of a significant association between OHIP-14 and financial status. Additionally, other studies which showed a significant relationship with financial status used measures of actual income as related to a determined poverty status^{16,17} rather than our measure of self-perceived satisfaction with financial status. The subjective nature of how we measured finances coupled with the relatively small numbers of persons who reported dissatisfaction with their finances might be related to the lack of significant association with the OHIP-14.

Our results found that self-assessed poor general health had a significant independent association with oral health related quality of life. As a cross-sectional study, these findings cannot determine cause and effect in terms of relationship between general health and oral health. However, the findings do suggest that our Japanese elderly who reported impaired general health also reported more oral problems. This association has been previously observed in other populations¹⁸.

When our OHIP SC data was compared with that of other countries, the items were ranked similarly (Table 6). It was interesting that the two top items most frequently reported in all countries except for Hong Kong were the subdomains of physical pain or psychological discomfort^{6,19}. Although the items were ranked similarly, the perceived magnitude of the problems were quite different in different populations⁷. The Osaka elders reported less impacts than did NC blacks or elders in Hong Kong,

Table 6 International comparisons using the OHIP SC.

Characteristic	Adelaide ^a n = 670 (74)		Mt Gambier ^a n = 266 (72)		NC White ^a n = 225 (75)		NC Black ^a n = 202 (74)		Toronto ^a n = 164 (70)		Rural Ontario ^a n = 115 (70)		Hong Kong ^b n = 586 (73)		Osaka n = 942, (66)	
	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank
Functional limitation																
Trouble pronouncing words	2.2	6	1.1	6	0.5	6	4.6	9	3.0	7	0.0	12	8.0	4	4.4	6
Taste worse	2.2	7	0.8	9	0.5	6	11.3	3	4.6	3	2.7	3	11.8	2	4.5	4
Physical pain																
Painful aching	3.4	4	2.6	5	1.1	4	7.2	7	6.8	2	8.3	1	3.4	8	4.5	4
Uncomfortable to eat	6.5	1	5.3	2	4.8	1	11.9	2	2.9	10	1.3	6	16.4	1	8.1	1
Psychological discomfort																
Self-conscious	5.6	2	6.0	1	3.2	2	14.0	1	8.2	1	4.0	2	3.4	8	5.2	2
Tense	4.4	3	3.0	3	0.5	6	9.8	4	3.7	4	1.3	6	3.9	7	4.9	3
Physical disability																
Diet unsatisfactory	0.7	11	0.4	11	0.5	6	4.0	10	3.7	4	1.3	6	4.7	5	3.9	7
Interrupt meals	1.7	8	0.8	9	0.0	10	4.0	10	2.2	11	1.3	6	10.2	3	1.4	10
Psychological disability																
Difficult to relax	1.4	10	1.1	6	1.0	5	7.3	6	3.0	7	1.3	6	2.4	10	2.1	8
Been embarrassed	2.9	5	3.0	3	2.1	3	7.8	5	3.7	4	2.6	4	4.4	6	2.1	8
Social disability																
Irritable with others	0.7	12	0.0	13	0.0	10	2.6	12	1.5	12	1.4	5	1.0	12	0.7	12
Difficulty doing jobs	0.5	13	0.4	11	0.0	10	1.3	14	1.5	12	0.0	12	0.5	14	0.5	13
Handicap																
Life unsatisfying	1.7	9	1.1	6	0.0	10	4.7	8	3.0	7	1.3	6	2.4	10	1.2	11
Unable to function	0.2	14	0.0	13	0.0	10	2.0	13	1.5	12	0.0	12	0.9	13	0.5	13
OHIP-14 SC	0.34		0.26		0.14		0.93		0.49		0.27		0.73		0.44	

n, number of people and the values given in parenthesis are median age in years.

^aSlade et al., 1996⁶.

^bWong et al., 2002¹⁹.