

図4 第一大臼歯部の咬合力.

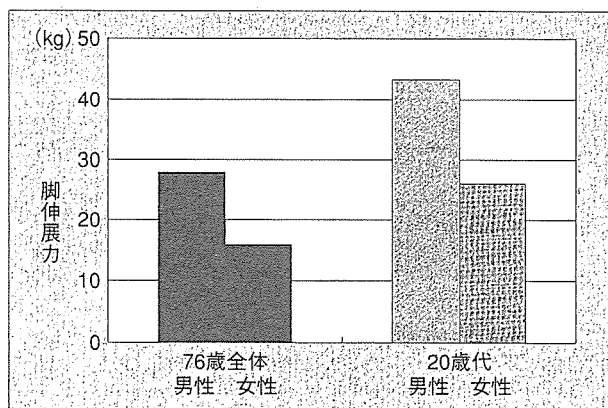


図5 脚伸展力.

表2 食品アンケートで提示した食品

山本式総義歯性能判定表における分類	3	4	5	6
食品	ごはん まぐろの刺身 うなぎの蒲焼き	こんにゃく ちくわ イカの刺身	らっきょう ビフテキ フランスパン 酢だこ 貝柱の干物 するめ	たくあん ピーナッツ 堅焼き煎餅

で20歳代の96.7%で、女性でも20歳代の73.8%と高い値を示す(図4)。一方、全身の筋力の指標として脚伸展力を比較すると、20歳代の平均値を100%とした場合に比べて男性で64.2%、女性で60.9%(図5)と低い値を示していた。

このような咬合力の結果を見ると、「高齢者の筋力は低い」という一般的な概念は、咀嚼筋については当てはまらない。しかし片顎が義歯であると、対合歯は天然歯であっても、咬合力は20歳代の1/3程度に低下してしまう。すなわち、高齢者の咬合力の低下は、筋力によるものでなくて、残存歯の喪失と義歯の影響によるものだ、ということがわかる。

また、片顎天然歯・片顎義歯群と両顎義歯群の咬合力に有意差はなかった。一般に、片顎でも天然歯を有するほうがよく噛める、と言われているが、そのことはこの結果とは相容れない。すなわち、「食

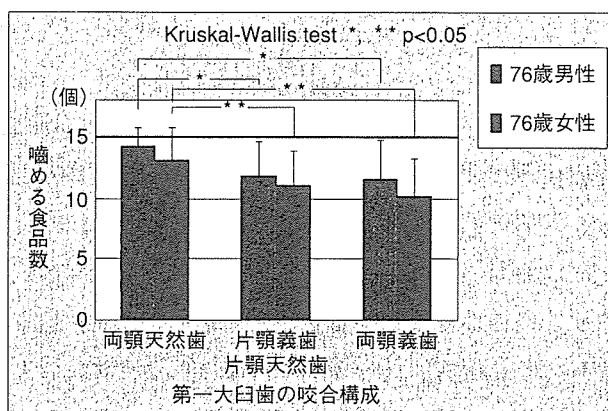


図6 噛める食品の数.

物が噛める」という感覚と咬合力が発揮されることは等しくない、と言えよう。

次に「噛める」こととは、どのような状態を指すのかを考察するため、食物について調査を行った。

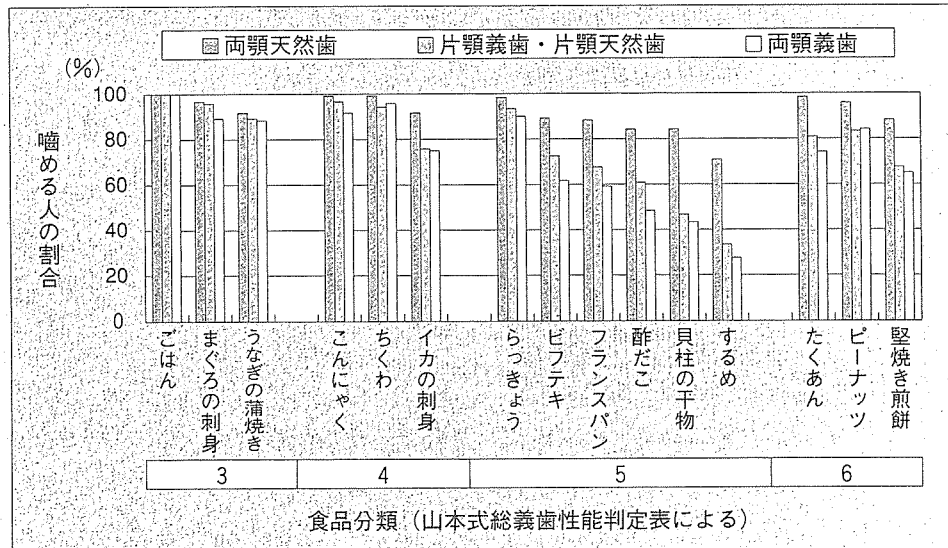


図 7 噛める人の割合 (食品別).

IV. 噛める食品

「山本式総義歯咀嚼能力判定表」³⁾から、食品15品目(表2)を抜粋しアンケートを行った。アンケートは、「次の食品について噛むことができますか」という質問に対して、噛むことができるものに自分で○をつける方式である。

1. 噛める食品の数

被験者が「噛める」と回答した食品の数を図6に示す。両顎天然歯の場合には、噛める食品の数は、男性で平均14.2品目、女性で平均13.1品目を示した。一方、片顎義歯、両顎義歯の場合には両顎天然歯に比べ2~3品目低い値を示したが、片顎義歯と両顎義歯の間に有意な差は認められなかった。噛める食品の数も、咬合力と同様に天然歯同士の咬合支持が大切であることを示している。

2. 噛める食品の種類

食品別に、「噛める」と回答した人の割合を図7に示す。食品は、「山本式総義歯咀嚼能率判定表」

の分類順に並んでいる。

1) 軟らかい食品

ごはん・まぐろの刺身・うなぎの蒲焼き・こんにゃく・ちくわ・らっきょうといった、比較的軟らかく容易に咬断できる食物では、義歯の有無にかかわらず高い割合で噛めている。

2) コシの強い筋張った食品

イカの刺身・ビフテキ・フランスパン・酢だこ・たくあんといった食物では、噛める割合は義歯の有無に影響を受けており、両顎天然歯で最も高く、義歯を有する場合は低い。非常に硬い貝柱の干物・するめは、義歯の場合にはたいへん噛みづらく、両顎天然歯の場合の半分の人しか噛めない。

興味深いのは、ビフテキ・フランスパン・酢だこ・たくあんといった筋ばった食物、擦り切るような咀嚼運動を必要とする食物では、片顎義歯の場合に(両顎義歯に比べて)高い率で噛める傾向を示したことである。このことは、擦り切るような咀嚼運動においては、片顎でも天然歯を有していることが有利に働くことを示している。これは、歯根膜の感覚が咬合力の発揮だけでなく、緻密な顎運動のコントロールにも寄与しているためであろう。

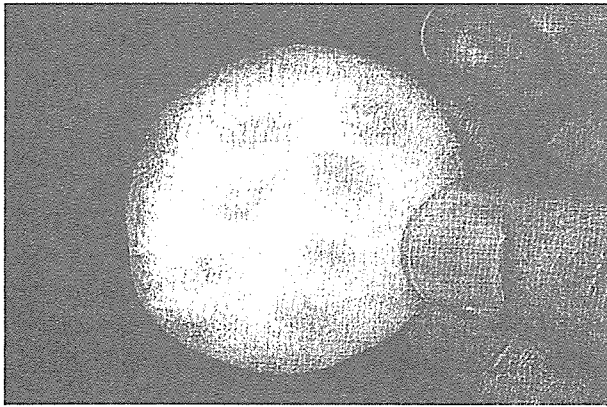


図8 試験に用いた煎餅（直径約50mm，厚さ約6mm）。

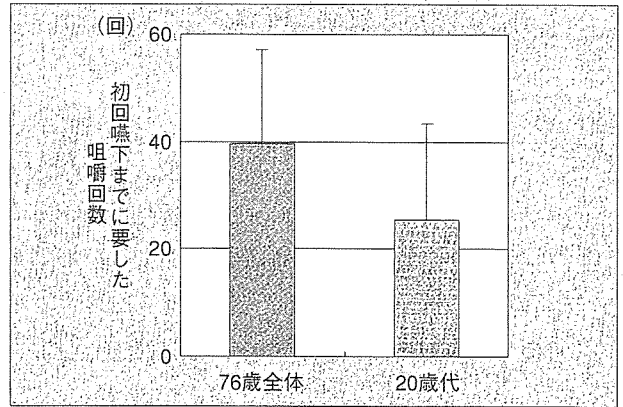


図9 食塊形成能力。

3) 硬く破碎性の食品

ピーナッツや堅焼き煎餅といった硬くても破碎性の食物においては、両顎天然歯の場合に噛める割合が高い傾向を示したが、片顎義歯と両顎義歯の間にほとんど違いはなかった。これらの食品の場合、噛み砕く力は必要だが、精密にコントロールされた顎運動はそれほど必要ではないのだろう。

V. 「噛むこと」における義歯の機能 ——義歯は意外によく噛める

上述した調査結果から、両顎天然歯と義歯を有する場合のそれぞれの機能的差異は、発揮できる咬合力や緻密な顎運動のコントロールと関連があり、また片顎義歯と両顎義歯の間の機能的差異は緻密な顎運動の可否と関連がある、と考えられる。

両顎天然歯の場合は咬合力が強く、器用に食物を擦りつぶすこともできる。片顎天然歯・片顎義歯では咬合力には劣るが、食物を擦りつぶすことはある程度できる。そして両顎義歯になると、いずれもやや苦手だ、ということである。たしかに義歯は天然歯の場合より噛みにくい。

しかし図7を見ると、一般に言われているよりはよく噛めているように思われる。たとえば、肉は義

歯で噛みづらい食品と言われるが、今回の調査では両顎義歯であっても半分以上の人が「ビフテキ」を噛めると回答している。硬い物の代名詞で、「山本式総義歯性能判定表」でも難易度が高いとされるたくあん、ピーナッツや堅焼き煎餅も高い率で噛める。

貝柱やすもめは、たしかに噛みづらいが、嗜好性が強く栄養の面から考えれば必須の食品とは言えない。したがって、天然歯ほどではないものの、義歯は意外にいろいろなものが食べられるようである。このように考えると、義歯を使用していても楽しい食事を摂ることは十分に可能であり、それによって高齢者のADL、さらにはQOLの向上が期待できるだろう。

診療室において、義歯を装着・調整し、患者さんがさまざまな食物にチャレンジできるようになった頃合いを見計らって、図7を参考に、どんな食品が噛めるのか問診して見ていただきたい。その義歯の客観的な成績が、ある程度見えてくるのではないだろうか。

VI. 食塊形成能力

実は、咀嚼とは単に食物を噛み砕き擦りつぶすだけの機能ではない。口腔内に取り込まれ、粉碎した

$$\text{咀嚼回数改善率 (\%)} = \frac{\text{義歯非装着時の咀嚼回数} - \text{義歯装着時の咀嚼回数}}{\text{義歯非装着時の咀嚼回数}} \times 100$$

図10 咀嚼回数改善率.

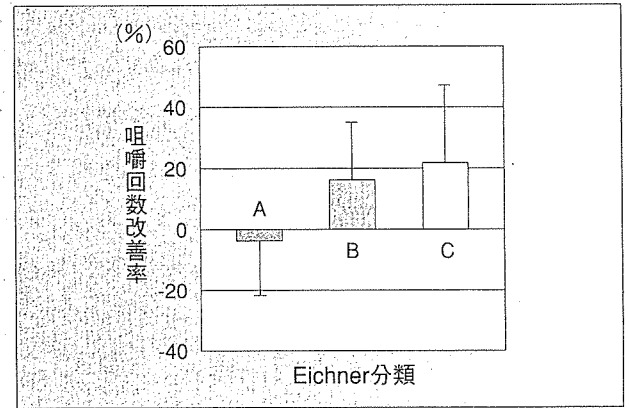


図11 義歯と食塊形成能力.

食物を食塊形成して嚥下に導く機能もある、と捉える必要がある。

食塊形成とは、細かく粉碎された食物を、歯列の内側(固有口腔)に移送・蓄積し、唾液と混和し、嚥下可能な性状にする作業を指す。食塊形成能力は、固有口腔への食物の集積度、唾液量等の影響を受けると言われている。本間ら⁴⁾の方法では、食物の粉碎能力とは区分して食塊形成能力を評価することができる。

被験食品として水分吸収量が高く、比較的軟らかい煎餅「さくさくサラダせん」(亀田製菓)1枚を用いる(図8)。これを半分に割り、一度に口腔内に入れ、自由に咀嚼してもらう。最初の嚥下が行われるまでに要した咀嚼回数を計測し、その値をもって咀嚼能力を評価した。すなわち、咀嚼回数が少ないほど食塊形成能力が高く、嚥下可能な食塊が早く形成できると評価される。義歯を使用している方は、義歯を装着している状態で計測を行った。

1. 食塊形成能力

20歳代と比較すると76歳全体では、初回嚥下までに1.6倍程度多く咀嚼する必要がある(図9)。高齢者においては、唾液量の低下や歯の喪失、欠損による固有口腔への食物の移送能力の低下によって食塊

形成能力が低下しているものと推測される。

2. 義歯と食塊形成能力

前項の被験者の中から義歯を装着している方を対象に、義歯を装着している状態と装着していない状態で咀嚼回数を調べた。実験への参加に同意された方は157名であった。義歯装着時と非装着時の咀嚼回数の差を義歯非装着時の回数で除した値(百分率)を咀嚼回数改善率(図10)とした。この咀嚼回数改善率と、アイヒナー分類の関係について分析した。その結果、義歯装着者では、アイヒナー分類において臼歯部の支持が少なくなるほど咀嚼回数の有意な減少を認めた(図11)。

すなわち、使用している義歯が臼歯部を含む義歯使用者においては、大きな形態となるほど、義歯の使用によって咀嚼の能力が向上することが明らかになった。

VII. 「飲み込むこと」における義歯の機能——義歯がないと上手に飲み込めない

咀嚼行動は、食物を粉碎し食塊形成して嚥下することによって終了する。金田ら⁵⁾は、「食物を固有

口腔へ移送し食塊形成を円滑に行うには、口腔前庭と固有口腔が仕切られ、確立されていることが重要だ」と述べている。今回の結果は、歯牙欠損が大きいほど義歯の装着によって食塊形成能力は改善することを示しており、金田らの説を支持するものである。すなわち、咬合接触に関係なく、臼歯部に義歯のような物体が存在することで、固有口腔を仕切り、食物を舌でまとめる作業は容易になる。義歯は、食物を細かくするだけでなく、食塊を形成して嚥下しやすくする役割も持っているのである。

言い換えれば、食物の粉碎能力の低い片側性遊離端義歯であっても、これを装着することにより食塊形成能力が大きく向上する効果がある、ということを最後に記したい。

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回復期リハビリテーション病棟を中心とした歯科診療の検討

藤田保健衛生大学七栗サナトリウム歯科

藤井 航・永田千里・三串伸哉

藤田保健衛生大学医学部歯科口腔外科

藤井 航・水谷英樹

藤田保健衛生大学医学部リハビリテーション医学講座

三串伸哉・才藤栄一・園田 茂

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臨床統計

回復期リハビリテーション病棟を中心とした歯科診療の検討

藤井 航^{1,2)}・永田千里¹⁾・三串伸哉^{1,3)}・水谷英樹²⁾
才藤栄一³⁾・園田 茂³⁾

要旨：当院は、リハビリテーション・緩和ケア・高齢者医療を中心とする病院である。当科は、2001年4月に口腔内環境の改善によるQOLの向上を目的に、入院患者を対象とし開設された。今回、われわれは開設後4年を経過したことから、受診患者の検討を行った。

総受診者数は1,034人、男性608人(58.8%)、女性426人(41.2%)、平均年齢は66.1±13.6歳であった。原疾患は脳卒中が大半を占め、多様な障害やリハビリテーションによるADLの改善に対応した診療が必要と考えられた。主訴は、義歯が合わないなど義歯に関する主訴、むし歯を治したいなど歯に関する主訴、口腔ケアを含めた歯石除去希望など歯周疾患に関する主訴の順であった。帰結は在宅が最も多く、以下、他院への転院、終了、死亡などであった。主な処置内容は義歯調整など義歯処置が最も多く、ブラッシング指導、歯石除去を含む口腔ケア、う蝕処置などであった。今後、歯科的治療や口腔ケアがリハビリテーションや高齢障害者のQOLに与える影響について、より検討すべきであると考えられた。

Key words : Convalescent rehabilitation ward, Dental treatment, Inpatient, Oral health care

緒 言

未曾有の高齢化社会を迎え、高齢障害者の人数も増加の一途をたどっている。これら高齢障害者のQOLを考えた場合、「食べる」という行為は非常に大きな意味をもつと考えられる。

当院は、リハビリテーション・緩和ケア・高齢者医療を中心とし、回復期リハビリテーション病棟106床を含む総ベッド数218床、診療科はリハビリテーション科(リハビリ科)、外科・緩和ケア(外科)、内科、歯科を有している病院である。当科は2001年の4月から口腔内環境の改善によるQOLの向上を目的に、非常勤歯科医師2人と非常勤歯科衛生士1人、診療日週2日にて、基本的には入院患者を対象とし開設された。その後、歯科衛生士の常勤化、診療日の週3日への増加、障害者用ユニットの導入などを経て現在にいたっている。今回、われわれは開設後4年を経過したことから、回復期リハ

ビリテーション病棟を中心とした歯科診療の現状および今後の課題について検討した。

対象ならびに方法

調査対象は、2001年4月1日～2005年3月31日までの4年間に、当科を受診した1,034人である。診療記録をもとに患者層、依頼科、原疾患、主訴、帰結などにつき検討を行った。

結 果

1. 患者層

総患者数は1,034人、男性608人(58.8%)、女性426人(41.2%)であり、調査期間中の当院総入院者数の26.1%であった。年齢は17～97歳、平均年齢は66.1±13.6歳(図1)、当科初診日から終診日までの平均歯科診療期間は50.1±56.8日であった。のべ患者数は、開設された2001年度は1,455人、2002年度2,088人、2003年度2,087人、2004年度は2,336人と歯科の当院内における認知度の上昇に伴い開設より約1.6倍の増加を示した。

2. 依頼科

リハビリ科が92.6%と圧倒的多数を占めた(表1)。当院入院から歯科初診日までの平均日数は37.9±131.4日であった。

¹⁾藤田保健衛生大学七栗サナトリウム歯科

(院長：園田 茂教授)

²⁾藤田保健衛生大学医学部歯科口腔外科

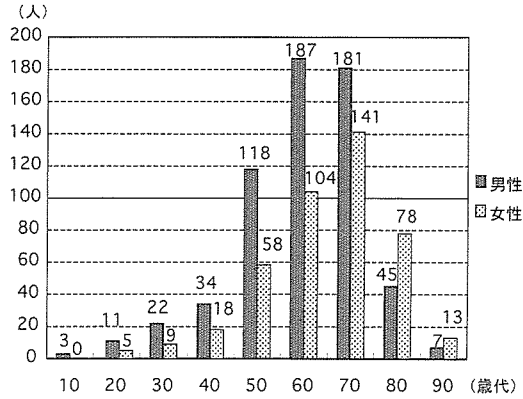
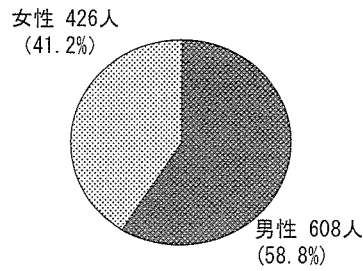
(主任：水谷英樹教授)

³⁾藤田保健衛生大学医学部リハビリテーション医学講座

(主任：才藤栄一教授)

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17-97歳, 平均年齢: 66.1 ± 13.6歳

図1 患者層 男女別と年代別

表1 依頼科

	(人)	(%)
リハビリテーション科 (リハビリ科)	958	92.6
外科 (緩和ケアを含む)	57	5.5
内科	19	1.8

表2 原疾患

	(人)	(%)
脳卒中	742	71.8
腫瘍	56	5.4
脳外傷	44	4.3
脊髄損傷	42	4.1
骨折	25	2.4
パーキンソン病	12	1.2
廃用症候群	6	0.6
内分泌疾患	6	0.6
呼吸器疾患	5	0.5
循環器疾患	3	0.3
その他	93	9.0

表3 主な主訴

	(人)	(%)
義歯に関するもの	483	46.7
合わない	338	32.7
新製希望	141	13.6
修理希望	4	0.4
歯に関するもの	336	32.5
むし歯を治したい	195	18.9
冠・詰め物がとれた	55	5.3
歯が痛い	37	3.6
抜いてほしい	31	3.0
抜けた	9	0.9
グラグラする	9	0.9
歯周疾患に関するもの	213	20.6
歯石除去希望	60	5.8
歯ぐきが痛い	37	3.6
歯ぐきから血が出る	7	0.7
口腔ケア希望	109	10.5
その他	3	0.3

3. 原疾患

脳卒中が大半を占め, 腫瘍, 脳外傷, 脊髄損傷, 骨折, パーキンソン病の順であった (表2).

片麻痺や四肢麻痺などの麻痺を有する患者は791人 (76.5%) であった. その対応として, 歯科室内外での移動, ユニットへの移乗・体位保持に対し, 当科では2005年に障害者用ユニットを導入し, また, 車いすからの移乗については当院の理学療法士や作業療法士による移乗の指導を受けることにより, 転倒や落下の危険性の減少を図った.

摂食・嚥下障害を有する患者は315人 (30.5%) であった. 摂食・嚥下障害に対し, 軟口蓋挙上装置 (Palatal Augmentation Prosthesis: PAP) や舌接触補助床 (Palatal Lift Prosthesis: PLP), スピーチエイドなどの歯科的な補綴装置の作製を言語聴覚士と共同にて行ったのは15人 (摂食・嚥下障害を有する患者のうち4.8%) であった.

tal Augmentation Prosthesis: PAP) や舌接触補助床 (Palatal Lift Prosthesis: PLP), スピーチエイドなどの歯科的な補綴装置の作製を言語聴覚士と共同にて行ったのは15人 (摂食・嚥下障害を有する患者のうち4.8%) であった.

4. 主訴

主たる主訴は, 義歯が合わないなど義歯に関する主訴, むし歯を治したいなど歯に関する主訴, 口腔ケアを含めた歯石除去希望など歯周疾患に関する主訴, その他の順であった (表3).

表4 帰結

	(人)	(%)
在宅	426	41.2
転院	324	31.3
施設	77	7.4
終了	64	6.2
死亡	62	6.0
外来	58	5.6
中断	3	0.3
継続中	20	1.9

5. 帰結

在宅が最も多く、次いで他院への転院、施設、治療終了、死亡であった(表4)。主な処置内容は義歯調整など義歯処置が最も多く、ブラッシング指導、歯石除去を含む口腔ケア、う蝕処置、治療途中の順であった(表5)。抜歯は150人(14.5%)に行っていた。治療途中のうち情報提供を行ったのは42人(70.0%)であった。

考 察

当科受診患者の患者層をみると、60、70歳代が多かった。このことは、当科が基本的には当院入院患者を対象として診療を行っているため、当院の特徴であるリハビリテーション・緩和ケア・高齢者医療を反映していると考えられる。

原疾患では脳卒中患者が大半を占めた。これは、当科への依頼状況においてリハビリ科が圧倒的多数を占めていることと大きな関連があり、当科では障害を有する患者への診療が主となっている。リハビリ科の中心的病棟である回復期病棟の入院期限が3カ月であることから、平均歯科診療期間が50.1日であったと考えられる。このように、診療可能な期間がある程度限定されているので、当院で行うべき治療内容と、近医でも行うことができる治療内容を考慮した治療計画を計画する必要がある。

また、リハビリテーションを行っている患者は、初診時と退院時ではADLが改善している場合が多く、当科においてもその改善度に応じた対応が重要であると考えられる。摂食・嚥下障害が改善した症例に対する食形態への対応としての咬合回復や、構音障害に対するPLPなどの作製は高齢障害者のQOLの向上に重要な意味をもつと思われる。

さらに、脳卒中患者には高次脳障害をもつものが多い。おのおのの障害に対する対応が必要であると考えられる。たとえば、失語の場合にはコミュニケーションが

表5 主な処置内容

	(人)	(%)
義歯処置	518	50.1
義歯調整	472	45.6
義歯修理	25	2.4
義歯新製	21	2.0
う蝕処置	181	17.5
口腔ケア	256	24.8
ブラッシング指導	220	21.3
口腔ケアのみ	26	2.5
歯石除去	10	1.0
抜歯処置	16	1.5
治療途中	60	5.8
その他	3	0.3

得られにくく、患者側の訴えや術者側からの診療内容の説明などに、十分な考慮が必要である。当科の場合には、必要に応じてコミュニケーションボードの使用や言語聴覚士の協力を得て、可及的にコミュニケーションを図るようにしている。

リハビリテーションと歯科の関連については、植田ら¹⁾はリハビリテーション専門病院の歯科的需要について、歯科需要と診療必要性が高いこと、ならびに重複障害として歯科的疾患を考慮に入れる必要のあることを指摘している。また、大野ら²⁾は総合病院における新しい歯科の役割としてリハビリ科内に歯科を開設したところ、口腔ケアの充実、さらに摂食・嚥下障害に対するアプローチの手法が広がったと報告している。また、鈴木ら³⁾は歯科的治療がADLの向上に関与していると報告している。これらの報告のように、リハビリテーションと歯科の関連性は大きく、歯科治療や口腔ケアがリハビリテーションに与える影響について、より検討すべきであると考えられる。

当科受診患者で最も多い主訴・処置内容ともに義歯処置であった。植田ら¹⁾や今井ら⁴⁾の報告でも義歯処置の必要性は高いとしている。当科を受診する入院患者の多くが回復期病棟であり、発症から3カ月以内の入院であることから、その間に起こる歯科的な疾患の進行はう歯や歯周疾患の増悪よりも、義歯の不適合または紛失が多いことが推察される。

帰結としては在宅が最も多かった。在宅では口腔に関する管理は患者自身によるところが大きいため、退院時に家族・介護者を含めた、より綿密な口腔ケア指導を行う必要があると考えられた。また、死亡例はそのほとんどが緩和ケア病棟の患者であった。大野ら²⁾は、ホス

ピス病棟では全身状態の悪化に伴い、口内炎や口腔カンジダ症が頻発するため口腔ケア頻度が高く、また本人や家族からの受診希望も多かったと報告している。人生の終焉を迎えるとき、口腔ケアや義歯処置などにより口腔内環境を機能的・審美的に回復することは残されたQOLの向上において大きな意味をもつものであろう。

主な処置内容は義歯処置に次いで口腔ケアが多かった。今回の検討では、主たる処置行為を挙げているためにこのような結果であったが、実際には口腔ケアはほぼ全症例に行っていた。口腔ケアについて大野ら²⁾、今井ら⁴⁾は看護師らによる口腔ケアに加えて、歯科医師・歯科衛生士の専門的知識の重要性を報告しており、当科でもより病棟や作業療法士などとの連携を深め、充実した専門的口腔ケアを行う必要性が予想される。

当科では14.5%に抜歯術を行っていた。脳卒中患者に対して原則的に発症後6カ月間は観血的処置は避けたほうがよいとされている⁵⁾。しかし、前述しているように回復期リハビリテーションによるADLの改善に対応した加療を行うとするならば、適応である抜歯は積極的に行うべきであると思われる。また、在宅へ戻った後に抜歯が必要となった場合には、その原疾患のためになかなか近医で抜歯を行うことはできず、最寄りの歯科口腔外科のある総合病院まで通院が必要となる。この場合、現在の全身状態、服薬など主治医との必要な情報交換などを行っている、抜歯当日までかなりの時間を要する。さらに抜歯のために入院が必要な場合もあり、本人や介護者に非常に大きな負担と労力を強いるものである。これらの点からも当院入院中に抜歯を行うことの必要性が示唆される。

退院時に他院での歯科または歯科医院に通院が今後必要であった60人については、その70.0%に対して情報提供を行っていた。しかし、その大半は継続した義歯調整、根管治療の依頼などであり、口腔ケアのみの場合では家族への指導、転院先への退院時看護サマリへの添付にて対応しており、情報提供としては行っていなかつ

た。平成18年4月に介護保険の見直しが行われ、口腔機能向上などの新たなサービスが導入されている。これにより、口腔ケアに関する情報提供の重要性はさらに増すものと考えられ、より情報提供率を上げる必要があると予想される。

結 論

回復期リハビリテーション病棟を中心とした病院の歯科診療の現状および今後の課題について検討を行った。当科では高齢者、特にリハビリ科入院患者が大半であり、ADLの改善や多様な障害に対する対応を主眼とし、他職種と連携した歯科診療が必要であると考えられた。今後、歯科的治療や口腔ケアがリハビリテーションや高齢障害者のQOLに与える影響について検討すべきであると考えられた。

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Clinical Analysis of Dental Treatment Chiefly in Convalescent Rehabilitation Wards

FUJII Wataru^{1,2)}, NAGATA Chisato¹⁾, MIKUSHI Shinya^{1,3)}, MIZUTANI Hideki²⁾,
SAITOH Eiichi³⁾ and SONODA Shigeru³⁾

¹⁾Department of Dentistry, Nanakuri Sanatorium, Fujita Health University
(Director : Prof. SONODA Shigeru)

²⁾Department of Oral and Maxillofacial Surgery, School of Medicine, Fujita Health University
(Chief : Prof. MIZUTANI Hideki)

³⁾Department of Rehabilitation Medicine, School of Medicine, Fujita Health University
(Chief : Prof. SAITOH Eiichi)

Our hospital primarily provides rehabilitation, palliative and geriatric care for patients. The Department of Dentistry was established for inpatients of the hospital in April of 2004 to raise their quality of life (QOL) by improving the condition of the oral cavity. Having been of service to inpatients for 4 years, we conducted a retrospective study for the purpose of improving our service.

A total of 1,034 people, 608 males (58.8%) and 426 females (41.2%), received dental treatment in our department. Their average age was 66.1 ± 13.6 years old. As stroke was the major etiology, we were expected to provide dental treatment in response to various dysfunctions they suffered and changes in activities of daily living (ADL) brought about as a result of rehabilitation treatment.

Chief complaints from the subjects were associated with the following : ill-fitting dentures and other denture-related problems, untreated dental caries and other tooth-related problems, and periodontitis including the lack of oral health care such as scaling of the teeth. Concerning the outcome, the majority of the subjects consequently went home and stayed there, some were transferred to other hospitals and nursing homes, some finished treatment, and some died. Denture adjustment consisted mostly of the treatment we provided, followed by oral health care including tooth-brushing instruction and descaling of the teeth, and treatment of dental caries.

In future studies, we should look into the influence of dental treatment and oral health care on rehabilitation and QOL of handicapped elderly people.

Oral health status and health-related quality of life: a systematic review

Mariko Naito¹⁾, Hidemichi Yuasa²⁾, Yoshiaki Nomura³⁾, Takeo Nakayama⁴⁾,
Nobuyuki Hamajima¹⁾ and Nobuhiro Hanada⁵⁾

¹⁾Department of Preventive Medicine/Biostatistics and Medical Decision Making,
Nagoya University Graduate School of Medicine, Aichi, Japan

²⁾Department of Oral and Maxillofacial Surgery, Central Hospital of Tokai Medical Institute,

³⁾Department of Preventive Dentistry and Public Health,

Tsurumi University School of Dental Medicine, Kanagawa, Japan

⁴⁾Department of Health Informatics, Kyoto University School of Public Health, Kyoto, Japan

⁵⁾Department of Oral Health, National Institute of Public Health Ministry of Health,
Labor and Welfare, Tokyo, Japan

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Abstract: This study was conducted in order to identify the literature on oral health status and health-related QOL, review the findings systematically, and assess the association between them. We performed a literature search of reports published between January 1973 and June 2004, using five databases including MEDLINE. Only studies that used validated generic health-related QOL instruments were selected. The reviewers evaluated selected articles independently and resolved disagreements by consensus. A total of 1,726 articles were retrieved and seven were selected for the review; five observational studies and two intervention studies. Four studies showed significant associations between oral health status and health-related QOL. Temporomandibular disorders were highly associated with reduced health-related QOL. Poor oral status linked to both craniomandibular and cervical spinal pain was associated with increased impairment of health-related QOL. Dissatisfaction with the teeth and mouth, and a sensation of dry mouth contributed to reduce health-related QOL. Providing

edentulous patients with implant-supported full dentures contributed to improve health-related QOL. Assessment of health-related QOL in relation to oral health with validated instruments remains insufficient. The present findings suggest that oral health status could affect health-related QOL in some settings; however, further evidence is needed to support this interpretation. (J. Oral Sci. 48, 1-7, 2006)

Keywords: QOL; oral health; health; systematic review.

Introduction

Oral diseases such as dental caries or periodontal disease are highly prevalent and their consequences are not only physical; they are also economic, social and psychological. They seriously impair quality of life (QOL) in a large number of individuals and can affect various aspects of life, including oral function, appearance, and interpersonal relationships (1).

Reisine reported the need for a comprehensive approach to study the social and psychological impact of oral disease in the 1980s (2-4). Growing recognition of the importance of QOL in the field of dentistry has since led to the development of a number of oral health-related QOL instruments (5). The need to consider oral health as an integral part of health, and the contribution of oral health

Correspondence to Dr. Mariko Naito, Department of Preventive Medicine/Biostatistics and Medical Decision Making, Nagoya University Graduate School of Medicine, 65 Tsurumai-cho, Showa-ku, Nagoya 466-8550, Japan
Tel: +81-52-744-2132
Fax: +81-52-744-2971
E-mail: mnaito@med.nagoya-u.ac.jp

to overall health-related QOL, has been stressed (6).

A recent Medline search found that the number of articles under the key words 'quality of life' and 'oral health' had increased dramatically. In fact, the number of articles published between 2000 and 2004 was three times higher than that between 1995 and 1999, and six times higher than that between 1990 and 1994. However, to date, no systematic reviews exist on oral health and health-related QOL.

In order to facilitate further research, we conducted a literature review of published articles. The purpose of this study was to identify the literature on oral health status and health-related QOL, review the findings systematically, and assess the association between them.

Materials and Methods

This literature study was part of the review project for "Oral Health and General Health", a study undertaken by a group of dental and medical practitioners, that began in April 2004. The study protocol is cited on the worldwide web (7). We addressed the following research questions: (1) "What kinds of evidence regarding oral health status and health-related QOL are available?" and (2) "What is the association between oral health status and health-related QOL?"

Definitions of "oral health" and "QOL" were consistent with those provided in the report "Oral Health in America" (8). In this classification, oral disease has six major categories: dental and periodontal infections, mucosal disorders, oral and pharyngeal cancers, developmental

disorders, injuries, and certain chronic and disabling conditions including orofacial pain. Oral health is defined as freedom from chronic orofacial pain; oral and pharyngeal cancers; oral soft tissue lesions; birth defects such as cleft lip and palate; and other diseases affecting the oral, dental, and craniofacial tissues, collectively known as the craniofacial complex. This definition was used to formulate the search strings in the present study.

QOL is defined as an individual's perception of his or her position in life, in the context of the culture and value systems in which they live, and in relation to their goals, expectations and concerns (9). Health contributes to QOL, and the real impact of health and disease on QOL is known as health-related QOL. Health-related QOL is one dimension of a wider concept of QOL (10), and is defined in relation to optimum levels of mental, physical, role, and social functioning; it includes relationships, as well as perceptions of health, fitness, life satisfaction, and well-being (11).

Oral health-related QOL is defined as an individual's assessment of how the following affect his or her well-being: functional factors, psychological factors, social factors, and experience of pain/discomfort in relation to orofacial concerns (12). These definitions of health-related QOL and oral health-related QOL were used in the present study.

The following databases were used for the literature search: MEDLINE, EMBASE, Cochrane Library, Up To Date and Japana Centra Revuo Medicina. Table 1 shows the search strings for MEDLINE. The search term

Table 1 Search strings for MEDLINE

#1	(Oral Health[mh] OR "Oral Health"[tw]) OR (Health Promotion[mh] OR "Health Promotion"[tw]) OR (Health Status Indicators[mh] OR "Health Status Indicators"[tw]) OR (Periodontal Diseases[mh] OR "Periodontal Diseases"[tw]) OR (Dental Caries[mh] OR "Dental Caries"[tw]) OR (Mouth Neoplasms[mh] OR "Mouth Neoplasms"[tw]) OR (Mouth Diseases[mh] OR "Mouth Diseases"[tw]) OR (Dental Health Services[mh] OR "Dental Health Services"[tw]) OR (Craniofacial Abnormalities[mh] OR "Craniofacial Abnormalities"[tw]) OR (Fluoridation[mh] OR "Fluoridation"[tw]) OR (Oral Hygiene[mh] OR "Oral Hygiene"[tw]) OR (Craniofacial Disorders[mh] OR "Craniofacial Disorders"[tw]) OR (Dental Care[mh] OR "Dental Care"[tw]) OR (Focal Infection, Dental[mh] OR "Focal Infection Dental"[tw]) OR (Endodontics[mh] OR Endodontics[tw])
#2	Dentistry[mh] OR Mouth Diseases[mh] OR Tooth Diseases[mh] OR Oral Health[mh] OR Jaw Diseases[mh] OR Craniofacial Abnormalities[mh] OR Dental Health Services[mh] OR Head and Neck Neoplasms[mh] OR Dentistry[tw] OR "Mouth Diseases"[tw] OR "Tooth Diseases"[tw] OR "Oral Health"[tw] OR "Jaw Diseases"[tw] OR "Craniofacial Abnormalities"[tw] OR "Dental Health Services"[tw] OR "Head and Neck Neoplasms"[tw]
#3	hominidae[mh] OR Human[mh]
#4	(#1 AND #2) AND #3
#5	(quality of life[mh] OR "quality of life"[tw]) OR (activities of daily living[mh] OR ADL[tw] OR "activities of daily living"[tw]) OR (EQ-5D[tw] OR EuroQol[tw] OR NHP[tw] OR QWB[tw] OR SF-12[tw] OR SF-36[tw] OR SIP[tw])
#6	1973/01:2004/06[dp]
#7	#4 AND #5 AND #6

“activities of daily living” (ADL) was also included in the strings because studies may have evaluated QOL as one of the factors contributing to ADL. The Quality of Well-Being Scale, which was one of the targeted health-related QOL instruments in the inclusion criteria, was first introduced in 1973 (13). We therefore searched for reports published between January 1973 and June 2004. The literature search was performed in July 2004.

The following intervention and observational studies were included: (1) intervention studies that assessed the subject’s QOL before and after the intervention, (2) intervention studies that compared QOL in an intervention and a control cohort, and (3) observational studies comparing QOL in subjects with oral/dental diseases and in controls. Studies that examined the maintenance of health-related QOL or the increase/decrease of health-related QOL were included.

Only studies that used health-related QOL assessment with six validated generic QOL instruments were selected. These instruments were the Sickness Impact Profile (SIP) (14), the Nottingham Health Profile (15), the Short-Form 36 Health Survey (SF-36) (16), the Short-Form 12 Health Survey (17), the EuroQol Quality of Life Scale (18) and the Quality of Well-Being Scale (QWB), (19,20). The present study focused on the relationship between oral health and health-related QOL. Studies that used health-related QOL as an outcome were selected and those using only oral health-related QOL as an outcome were excluded. We excluded narrative reviews and studies involving patients who had undergone treatment that could have altered their oral environment, such as radiotherapy and/or chemotherapy for maxillofacial trauma. Studies involving patients with oral mucosa disease with both oral and other systemic symptoms (such as Behçet’s disease and Sjögren’s syndrome), were also excluded because factors not related to oral health might also have affected subjects’ health-related QOL.

Articles were selected and reviewed by two reviewers. First, each reviewer independently selected the articles from their abstracts. Second, they checked the contents of these selected articles and those without abstracts. Articles that did not clearly fulfill the criteria described above were excluded. The eligibility of selected articles was discussed. When two reviewers disagreed on the inclusion of an article, a third reviewer’s opinion was sought for further discussion. Agreement between two reviewers (κ) was calculated when determining the validity of reviewed studies. After selecting the reviewed articles, the reviewers evaluated all articles independently and resolved disagreements by consensus.

Results

1. Literature search and article selection

A total of 1,726 articles from 1973 to 2004 were retrieved, comprising 1,348 from MEDLINE and 378 from other medical databases. Two reviewers checked and then selected six and seven articles respectively (Fig. 1). All selected articles were original studies listed on MEDLINE. The most common reason for exclusion was either a lack of description of overall QOL or inclusion of cancer patients. Several studies were also excluded that involved patients with certain health conditions that could alter the oral environment. The two reviewers disagreed on the inclusion of three of the retrieved articles, owing to differing interpretations of the inclusion criteria. After consulting a third reviewer, one of these articles was excluded because the subject’s QOL before an intervention had not been assessed. The remaining two articles were finally included. A total of seven articles (21-27) were selected for the present study. The κ value indicating agreement between the two reviewers was 0.77 (95% CI: 0.51-0.99).

2. Classification of articles

Five observational studies and two intervention studies were reviewed (Tables 2 and 3). The observational studies consisted of four cross-sectional studies (21-23,25) and a case-control study (24). The intervention studies consisted of a clinical trial (26) and a randomized controlled trial (27).

Observational studies were concerned with dental and periodontal infections (21-24), temporomandibular disorders (TMD) (21) or orofacial pain (25). All intervention studies concerned outcomes in edentulous patients treated with dentures. None of them assessed how improvement in oral health due to oral care might affect health-related QOL.

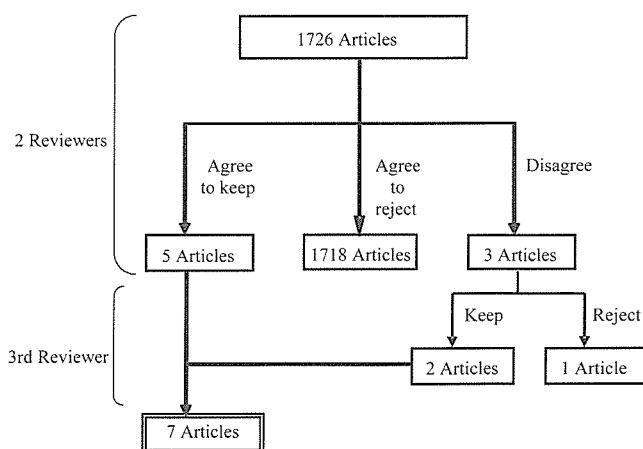


Fig. 1 The screening process to select articles for the review.

Table 2 Selected articles: observational studies

Year published	Study design	Subjects	Number of subjects	Oral health variables	HQOL instruments	OHQOL instruments	Association between HQOL and oral health status	Reference
1989	Cross-sectional study	TMD patients	48	TMD, Periodontal disease, Wearing dentures	SIP	-	TMD patients ranked lower on QOL, followed by denture and periodontal disease ($p<0.001$).	21
		Periodontal patients	33					
		Denture patients	23					
		Recall patients	48					
1999	Cross-sectional study	Edentulous patients with a history of difficulty wearing conventional dentures requesting dental implants	32	Tooth loss, Satisfaction with conventional dentures	SF-36	+	ns	22
		Edentulous patients requesting the replacement of their conventional dentures	35					
		Dentate patients	21					
2000	Cross-sectional study	Adolescents aged between 12 and 17	76	DMFS*	SF-36	+	ns	23
2003	Case-control study	Age-matched and gender-matched non-diabetic subjects	102	Tooth loss, Satisfaction with teeth and mouth, Oral dryness	SF-36	-	Diabetes subjects with few remaining teeth scored lower in PF and RP than those with ≥ 20 teeth ($p<0.01$). Dissatisfaction with the mouth and sensation of oral dryness was associated with lower scores in BP, VT and MH ($p<0.001$)†.	24
		Type 2 diabetes subjects	102					
2004	Cross-sectional study	Subjects with no pain	36	Craniomandibular pain, Cervical spinal pain, Widespread pain	RAND-36‡	-	Subjects with both craniomandibular and cervical spinal pain showed lower scores in all health domains than those with no pain ($p<0.01$).	25
		Patients with craniomandibular pain alone	12					
		Patients with cervical spinal pain alone	6					
		Patients with both craniomandibular and cervical spinal pain	49					

*Dental caries prevalence

†Financial status was adjusted.

‡The Dutch version of the SF-36

TMD, Temporomandibular disorders; ns, not significant

HQOL, Health-related QOL; OHQOL, Oral health-related QOL

PF, Physical functioning; RP, Role-physical; BP, Bodily pain; VT, Vitality; MH, Mental health

Table 3 Selected articles: intervention studies

Year published	Study design	Experimental group			Comparison group			HQOL instruments	OHQOL instruments	Association between HQOL and oral health status	Reference
		Subjects	Number of subjects	Treatments	Subjects	Number of subjects	Treatments				
2003	Clinical trial	Edentulous/edentate subjects and subjects requesting implants	26	Prostheses supported by implants	Dentate patients	20	Routine conservation and simple periodontal treatments	SF-36	+	ns	26
		Edentulous/edentate subjects and subjects requesting implants	22	Conventional dentures							
		Edentulous patients requesting the replacement of their conventional dentures	35	Conventional dentures							
2003	Randomized controlled trial	Edentulous patients	30	Mandibular overdentures retained by two implants and conventional maxillary dentures	Edentulous patients	30	Conventional full dentures	SF-36	+	The experimental group scored higher on post-treatment in RE, VT and SF than those on pre-treatment ($p<0.05$).	27

ns, not significant

HQOL, Health-related QOL; OHQOL, Oral health-related QOL

RE, Role-emotional; VT, Vitality; SF, Social functioning

The following health-related QOL instruments were used in the selected studies: the SF-36 in six studies (22-27), and the SIP in one study (21). Four studies used both health-related QOL and validated oral health-related QOL instruments (22,23,26,27).

3. Quantitative research synthesis and qualitative analysis

None of the articles provided data necessary to perform a quantitative synthesis of research results. Three observational studies and one intervention study found associations between oral health status and health-related QOL. One observational study concerning TMDs indicated that they were highly associated with reduced health-related QOL (21). Tooth loss in type 2 diabetes subjects and poor oral status with both craniomandibular and cervical spinal pain were associated with increased impairment of health-related QOL (24,25). Dissatisfaction with the teeth and mouth, and a sensation of dry mouth contributed to a reduction in health-related QOL (24). However, edentulous jaws, periodontal disease, and increased dental caries were not correlated with health-related QOL (22,23). One intervention study indicated that providing edentulous patients with implant-supported, full dentures contributed to improved health-related QOL (27).

Discussion

A total of 1,726 articles were retrieved and seven articles (five observational and two intervention studies) were selected for the review. Four of these seven studies found associations between oral health status and health-related QOL.

Dental caries and periodontal disease have historically been considered the most important global oral health burdens. Moreover, tooth loss and impaired oral function have come into focus as health problems in recent years (28). It should be noted that the growing incidence of diabetes may further impact negatively on oral health (28). The topics covered by the selected articles in this review followed this trend in the oral health field.

A lack of evidence concerning the association between oral health and health-related QOL implies that a lack of suitable instruments for measuring oral health has impeded research progress. For instance, although the number of teeth is one measure of oral health status, individuals with no teeth can, in some cases, chew much better than those with partial dentures (29). This needs to be considered when addressing oral health.

One indicator of oral health is the number of remaining teeth. However, Gift (29) has suggested that it is difficult

to assess dental function and esthetic condition using the number of teeth without data on prosthetic work. Oral satisfaction among people with an edentulous jaw who have dentures has been reported to be relatively high (30), suggesting that the association between the number of remaining teeth and difficulty with everyday activities is far from definite. Allen et al. have also shown that the edentulous jaw is not correlated with health-related QOL (22). When considering how the number of teeth and oral satisfaction affect health-related QOL, it may be necessary to take into account other factors such as the subject's physical health and level of awareness regarding oral health.

In assessing the association between health status and health-related QOL, Heydecke (27) suggested that both specific and generic instruments be used. To examine what impact the maintenance and/or improvement of oral health has on health-related QOL, it is essential to collect evidence from several studies that evaluate health-related QOL. Discussion of the validity of QOL instruments is also needed. Several studies have indicated a problem regarding the use of original QOL instruments that have not been tested for validity or reliability (31,32). Our study required articles to use established instruments, which may have limited the number of articles used. Further assessment of health-related QOL with valid instruments is needed.

Four of the seven studies indicate an association between oral health status and health-related QOL. This suggests that oral health status can affect the impact of health-related QOL in patients with particular conditions. It should, however, be noted that reviewed articles were limited in methodological quality and variety. Hence, further research is needed to clarify this relationship, in light of the insufficient number and quality of articles reviewed in this study.

Our review found that only intervention studies examined functional recovery and that no studies focused on primary prevention. In the field of oral health, it is still uncommon for intervention studies on primary prevention to assess outcomes relating to or concerning health-related QOL. Further research is accordingly needed on the importance of health-related QOL in the context of oral health promotion. Moreover, there were no studies on mal-occlusion and orthodontic conditions. Most orthodontic conditions are asymptomatic and relate to esthetics; therefore, generic health-related QOL may not be an appropriate measurement in many cases, particularly in relation to treatment needs and outcomes. Cunningham et al. (33) have suggested that there has been little research undertaken in the field of orthodontics and health-related QOL, and have recommended health-related QOL

assessment in future research.

It cannot be denied that publication bias may have reduced the number of reports included. In particular it should be mentioned that if observational studies do not show statistically significant results, it is often difficult for these studies to be published. Although oral health status may have some impact on health-related QOL, it is not easy to evaluate the extent of this impact. It will also be necessary to determine whether this impact is meaningful in the clinical setting. More evidence of this kind is therefore needed.

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Original

Effect of Disaccharide Xylosylfructoside on Sucrose Cariogenicity in an Artificial Mouth System

Takeshi KAMODA, Toshio IMAI, Tsutomu SATO, Susumu IMAI*,
Tosiki NISIZAWA* and Nobuhiro HANADA*

Abstract : It has been reported that xylosylfructoside (XF) effectively inhibited the synthesis of water-insoluble glucan (WIG) and adherence of mutans streptococci to smooth surfaces. The purposes of this study were to examine the cariogenicity of XF and assess the inhibitory effect of XF against the cariogenicity of sucrose using culture and artificial mouth systems. *S. mutans* MT8148 was cultured in heart infusion broth containing 1% sucrose with 0-5% XF in a glass test tube. The amounts of WIG and bacterial cells in the adherent fraction were significantly inhibited by XF in a dose-dependent manner. In the artificial mouth system, 1% XF did not inhibit the formation of artificial biofilm and enamel demineralization in the presence of 1% sucrose, but 2.5% XF significantly inhibited the formation of biofilm on enamel slabs, pH decrease underneath the biofilm, and enamel demineralization, suggesting that an appropriate concentration of XF could inhibit, in part, the cariogenicity of sucrose.

Key words : Xylosylfructoside, Artificial mouth system, Cariogenicity, Biofilm formation, Mutans Streptococci

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Introduction

Dental caries are analogous to bacterial infectious diseases involving a variety of factors^{1,2}. A causal relationship between sucrose and dental caries has been clarified by epidemiologic and animal studies^{3,4}. Sucrose is transported into mutans streptococci and other oral bacteria and metabolized into organic acids, resulting in enamel demineralization. Moreover, sucrose is utilized by mutans streptococci as a substrate for glucosyltransferases (GTFs) which are involved in the synthesis of the adhesive water-insoluble glucan (WIG), responsible for the formation of cariogenic biofilm^{4,9}. Consequently, numerous attempts directed at the prevention of dental caries have been performed using either sugar substitutes that do not ferment easily or GTF inhibitors.

Various non- or low-cariogenic sweeteners including oligosaccharides and sugar alcohols have been developed and applied worldwide¹⁰. Xylosylfructoside (O- α -

D-Xylp-(1 \leftrightarrow 2)- β -D-Fruf, XF) is a non-reducing disaccharide composed of xylose and fructose that has the same glycosidic bond as sucrose¹¹. It was reported that XF effectively inhibited WIG synthesis and the adherence of mutans streptococci¹¹, as well as competitively inhibiting the sucrose degradation activity of GTF as a sucrose analog and reducing sucrose consumption¹². Although XF was not easily fermented by mutans streptococci, the cariogenicity of XF itself and inhibitory effect of XF against sucrose have not yet been examined.

The aims of this study were thus to examine the cariogenicity of XF and to assess the inhibitory effect of XF on the cariogenicity of sucrose using an artificial mouth system (AMS).

Materials and Methods

1. Bacterial strain and culture conditions

Streptococcus mutans MT8148 was used for this study. Following pre-culture, *S. mutans* was cultured in brain

Department of Oral Health, School of Life Dentistry at Tokyo, The Nippon Dental University

* Department of Oral Health, National Institute of Public Health

heart infusion broth (BHI : Difco Laboratories, Detroit, MI) at 37°C for 16 hours. Bacterial cells were collected by centrifugation (6,000 rpm, 10 min), and washed once with phosphate-buffered saline, pH 7.2 (PBS). The cell suspensions of bacteria in PBS solutions were adjusted to an optical density of 2.0 at 500 nm (5.0×10^8 colony forming units/ml).

2. XF

XF was synthesized by the method of Avigad et al.¹⁹⁾ using levan-sucrase of *Bacillus subtilis* var *saccharolyticus* and provided by Dr. Kitahata (Osaka Municipal Technical Research Institute).

3. Adherence assay in culture system

The effect of XF on the synthesis and adherence of WIG and adherence of mutans streptococci to a glass surface were examined by batch culture. Twenty μ l of subcultured *S. mutans* MT8148 was inoculated into 2 ml of heart infusion broth (HI : Difco Laboratories) containing 1% sucrose and 0-5% XF, and the bacterium was cultured at 37°C for 17 hr in a small glass test tube at a 45° angle. After cultivation, bacterial cells and WIG were fractionated into firm-adherent, loose-adherent, and non-adherent fractions. The cultured tube was rotated gently 3 times and non-adherent culture was poured into another test tube. The original test tube was washed with 2 ml of PBS. Washing was combined with non-adherent culture and this fraction was referred to as the non-adherent fraction. Two ml of PBS was added to the original test tube and shaken by a mixer (Scientific Industries, NY, USA) for 10 sec. The upper fraction by this procedure was the loose-adherent fraction, and the residual fraction on the glass surface was the firm-adherent fraction. In non-adherent and loose-adherent fractions, bacterial cells and WIG were precipitated by centrifugation (25,000 rpm, 20 min) at 4°C. Two ml of 0.5 N NaOH was added to each adherent fraction to resolve WIG on the bacterial cell surface, and cells and WIG were separated by centrifugation (25,000 rpm, 20 min) at 4°C. The amount of cells in each fraction was measured by turbidity at 500 nm after suspension in 1 ml of PBS. WIG in the supernatant was determined colorimetrically at 492 nm by the phenol-sulfuric acid method¹⁴⁾ using glucose as a standard.

4. Biofilm formation and enamel demineralization in artificial mouth system

1) Preparation of enamel slabs

Enamel slabs with a flat surface, 3.5 × 3.5 × 1.5 mm in size, including dentine were prepared from the central part of the labial surface of unerupted bovine lower incisors. The enamel slabs were gradually polished using wet abrasive paper and finally with 1 μ m grade polishing film. Nine symmetrical points on the surface of each slab were measured for hardness with a diamond Vicker's indenter on a microhardness tester (Akashi Seisakusho Ltd., MVK-E) loaded with 200 g. Slabs with mean Vicker's hardness values of 280 to 320 were used in the experiments. The area of each enamel slab was measured using a micrometer caliper (Mitsutoyo, CD-15, Kawasaki, Japan).

2) AMS

The AMS consisted of two identical columnar artificial mouths, thermostatic incubator, multiple pH meter, peristaltic pump, and cooling stirrer (Fig. 1). The artificial mouth (60 mm in diameter, 140 mm in height) and surrounding water jacket (140 mm in diameter) were made from transparent vinyl chloride. Warm water was circulated by the thermostatic incubator (Taitech, Saitama, Japan) to maintain the temperature of the artificial mouths at 37°C. A pH electrode with a flat bulb (9 mm in diameter, TOA-DKK, Tokyo, Japan) was set upside down in the center of the artificial mouth with a silicon plug. Four enamel slabs were arranged on the flat surface of a special Teflon holder (24 mm in diameter) around the bulb of the electrode. Another silicon plug with five stainless steel tubes and a thermometer was set on the upper part of the artificial mouth to constantly supply HI medium supplemented with sucrose, PBS, or XF in PBS, and bacterial cell suspension with a peristaltic pump (Furue Science, Tokyo, Japan). The cell suspension ($OD_{500} = 2.0$) was maintained at a low temperature using a cooling stirrer (Iwaki Glass, Tokyo, Japan) during the experiment. Changes in pH underneath the artificial biofilm were continuously monitored with a multiple pH recorder (TOA-DKK, Tokyo, Japan). All procedures were conducted under aseptic conditions.

3) Evaluation of quantity of artificial biofilm and enamel demineralization

After stopping the operation of the AMS, the entire