〈Special article〉

Factors Related to Oral Health Status of Disaster Victims 9 Months after Great East Japan Earthquake

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東日本大震災 9 か月後の被災地住民の口腔の健康状態に関する要因

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＜ Abstract ＞

Nine months after the Great East Japan Earthquake, we performed an oral health survey including questionnaire and oral examinations for 2001 individuals living in Otsuchi Town, one of the most severely damaged municipalities by the disaster.

As compared with Japanese national survey, our subjects had greater numbers of decayed teeth and teeth with a periodontal pocket. Among 357 subjects who had visited dental facilities before the disaster, the dental care remained interrupted in 35.6% at the time of the survey. Past and current oral conditions were worse in subjects whose dental care remained interrupted or whose removable dentures had been lost or damaged as compared to others. In conclusions many living in a severely damaged area required dental care at 9 months after the disaster. Providing continuous dental care was needed for people in the victim area.

＜要旨＞

東日本大震災から 9 か月後，我々は被災地の中でも最も震災被害が大きかった自治体の 1 つである大槌町において，2001 名の住民に対してアンケートと口腔診査による口腔保健調査を行った。その結果，同年行われた国の保健統計調査である歯科疾患実態調査と比較して，調査対象集団において未処置歯，歯周ポケットを有する者の割合が高かった。また震災前に歯科受診していた 357 名のうち，35.6% の者が調査時点でいまだ歯科治療が中断されたままだった。歯科治療が中断されたままだった者および可撤性床義歯が紛失もしくは破損した者において，震災後に食事や会話に問題を感じた者が多く，かつ調査時点での口腔の主観的健康状態も不良であった。

結論として，震災から 9 か月経過した時点においても被災地住民は歯科保健医療を必要としていた。震災直後には多くの医療支援が行われたが，被害の大きい被災地域ではその後の継続的歯科保健医療の提供が必要である。

Keywords

dental treatment behavior	歯科受療行動
community dentistry	地域歯科保健
disaster	災害
oral health survey	歯科保健調査
epidemiology	疫学

I. Introduction

On March, 11, 2011, a larger earthquake (The Great East Japan Earthquake) with a measured magnitude of 9.0 followed by a giant tsunami struck the north-east area of Japan facing the Pacific Ocean, with many towns and cities suffering catastrophic damage. Consequently, many functions of the administrative and medical institutions in those communities were lost, while most survivors were forced to live in shelters or temporary accommodations. According to TV and newspaper reports immediately after the disaster, water availability was insufficient, and meals were mainly from freeze-dried pouches or mass production bread. Therefore, the oral hygiene of the victims likely deteriorated, as lack of water can reduce oral care performance, and foods containing abundant sugar and caking additives can easily stagnate in the oral cavity and on tooth surfaces. Furthermore, an unbalanced diet may adversely affect the oral mucosa and periodontal tissue. Hence, there was community concern about decreases in oral as well as systemic health. However, it is unclear how disaster-related subsequent changes in lifestyle influence oral health, as few studies of post-disaster conditions of oral health in victims have been reported.[1,2] In the present study, we surveyed the oral health conditions of community dwelling individuals in Otsuchi Town, which was severely affected by the disaster, 9 months after the earthquake.

II. Methods

1. Subject town

Otsuchi Town, located on the Pacific Ocean coast of Iwate Prefecture, Japan, suffered some of the most severe damage in The Great East Japan Earthquake (Figure 1). The main industries in the area are fisheries and fishery related businesses such as processing and services. The main administration, commerce, sightseeing, and inhabitable areas were located primarily along the coastline, and inundated by a giant tsunami. Dental facilities were exclusively located in this area (Figure 2). Prior to the disaster, there were 6 dental offices

Figure 1 Location of Otsuchi town in Iwate Prefecture

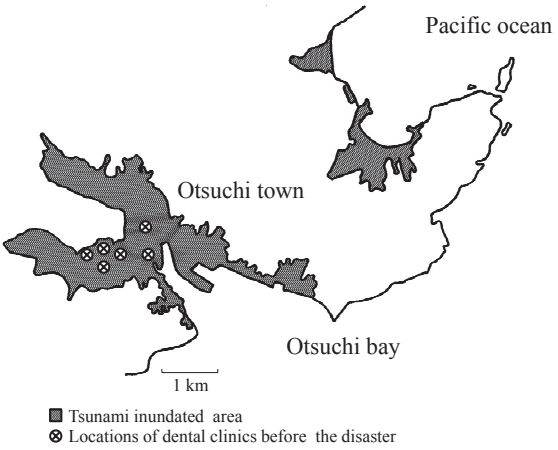

Figure 2 Tsunami inundated area of Otsuchi town.

in the town, all of which were destroyed. At the time of our survey (9 months after the disaster), dental services were being provided by a temporary dental clinic.

2. Subjects

The pre-disaster population of Otsuchi Town in 2010 was 15,300. According to the report of the town administration in October 2011, the total number of dead and missing in the disaster was 1322 (8.6% of population). In addition, a large number had evacuated and were living elsewhere. Consequently the population at the time of our survey was decreased to approximately13,000.

We attempted to investigate the oral health status and oral health-related experiences following the disaster of all adult dwellers of Otsuchi Town 18 years old or older. Our survey was planned to be performed at the same time of systemic health check-up examinations, which were conducted by the town government as a public health service. Prior to the examinations, town officials notified all inhabitants 18 years old or older and recommended their participation. Eleven venues for the check-up examinations were prepared during the 15-day survey period (December 8-22, 2011), since Otsuchi Town consists of an amalgamation of several smaller and geographically separate communities. At the reception for the check-up in each venue, informed consent to participate was obtained from the subjects. Finally, 2001 individuals participated in our study, with age and gender summarized in Table 1.

This study was approved by the Medical Ethics Committee of Iwate Medical University (H23-69) and conducted in accordance with the guidelines of the Declaration of Helsinki.

3. Data collection

Geographic data for subject homes before disaster were obtained from the town administration. To classify damage levels caused by the disaster, the subjects were divided into 3 groups based on the degree of destruction of their home, as follows: 1. no damage, 2. partially destroyed or flooded, 3. entirely destroyed.

Field surveys including questionnaire surveys and oral examinations were performed from December 8-22, 2011. For the questionnaire surveys we used a custom designed questionnaire, consisting of the following items. First, we queried experiences with dental care. The subjects were asked whether there was an interruption of dental therapy being received before the disaster. The answer choices were "no dental care was being received before the disaster", "care is continuing", "care was interrupted and has been resumed," and "care remains interrupted." We also asked regarding loss or fracture of a plate denture as a result of the disaster, and the answer choices were "yes", "no," and "wearing no dentures". If the respondent chose "yes," they were subsequently asked whether they had received a re-restoration or repair of the denture prior to the day of the survey. Next, we queried the history of oral status. The subjects were asked whether oral-health related problems occurred after the disaster, such as "difficulty with eating", "difficulty with speaking," and "ashamed to laugh". In addition, current oral-health status was assessed by each subject into 4 levels; "very good" (score 1), "good" (2), "not so good" (3), and "bad" (4).

To complete the questionnaire, interviews were done by public nurses or dental hygienists. After the questionnaire survey, oral examinations were performed. Dental caries status was assessed according to the method of the World Health Organization (WHO). Subsequently, periodontal conditions were assessed using a community periodontal index (CPI) based on procedures and diagnostic criteria recommended by the WHO.[3)]

4. Data analyses

Descriptive statistics were produced to reveal the oral health status of the subjects and compare them with national averages. To compare proportions between subjects and national survey results, Fisher's exact test was used, while a t test was used to compare averages between those. To examine the relationships of age and damage level with oral health condition, a chi-squared test followed by a multiple comparisons test using the Ryan method was performed.[4)] Similarly, a chi-squared test was used for analyses of

Table 1 Numbers of subjects by age and gender

		Age group (in years)							Total
		18-29	30-39	40-49	50-59	60-69	70-79	≥80	
Male	Population[a]	628	689	792	1019	1118	798	366	5410
	No. of subjects	22	48	66	97	245	236	55	769
	(percent)	(3.50)	(6.97)	(8.33)	(9.52)	(21.9)	(29.6)	(15.0)	(14.2)
	Average age[b]	24.1±4.4	35.2±2.7	44.2±2.7	55.1±2.8	64.9±2.7	73.9±2.8	82.3±2.0	62.9±14.2
Female	Population[a]	635	603	812	953	1176	1131	777	6087
	No. of subjects	37	101	131	196	406	283	78	1232
	(percent)	(5.83)	(16.7)	(16.1)	(20.6)	(34.5)	(25.0)	(10.0)	(20.2)
	Average age[b]	24.9±3.2	34.4±2.8	44.6±3.8	55.1±2.8	64.3±2.9	73.8±2.6	82.5±2.7	60.4±14.5
Total	Population[a]	1263	1292	1604	1972	2294	1929	1143	11497
	No. of subjects	59	149	197	293	651	519	133	2001
	(percent)	(4.67)	(11.5)	(12.3)	(14.9)	(28.4)	(26.9)	(11.69)	(17.4)
	Average age[b]	24.6±3.7	34.7±2.8	44.4±3.4	55.1±2.8	64.5±2.9	73.8±2.7	82.4±2.4	61.4±14.4

[a]Source: Government of Otsuchi Town. Population numbers for subjects 18-20 years old were estimated from the values for the age group 15-19 years old.

[b]Values show average age in years ± standard deviation.

the relationships among responses to our questionnaire. In addition, to compare averages among multiple groups, Sheffe's multiple analyses of variance (ANOVA) was utilized. Statistical analyses were performed using the software package SPSS 19.0 for Windows (SPSS Inc., Chicago, IL, USA).

Ⅲ. Results

1. Comparisons of oral conditions between subjects and national survey

The average numbers of present and decayed teeth in our subjects as compared with those obtained in the National Survey of Dental Health in 2011.[5] Data are summarized by age and gender in Table 2. In subjects aged 40 years and older, there were lower numbers of present teeth as compared with the national averages for both gender groups. Also, a comparison of the numbers of decayed teeth between our subjects and the national averages showed that the present subjects in the 40s and 50s age groups had greater numbers of decayed teeth. On the contrary, for

Table 2 Average numbers of present and decayed teeth in subjects by gender and age group[a]

		Age group (in years)						
		18-29	30-39	40-49	50-59	60-69	70-79	≥80
Male	Present	28.6±1.06	27.9±3.18	24.6±4.68**	19.9±8.46**	16.5±9.79**	12.1±10.1**	9.60±10.1*
		(28.9)	(28.5)	(27.4)	(25.0)	(22.0)	(16.6)	(12.4)
	Decayed	1.45±2.54	2.21±3.77	2.95±4.16**	1.52±2.28	1.12±2.24	1.02±2.27	0.84±1.78**
		(1.44)	(1.25)	(0.91)	(1.17)	(1.12)	(1.24)	(1.50)
Female	Present	28.5±1.74	28.1±2.23	25.5±3.97**	20.3±7.12**	13.7±9.68**	7.45±9.18**	5.60±7.21**
		(28.1)	(28.4)	(27.5)	(25.1)	(21.8)	(16.5)	(9.92)
	Decayed	0.49±1.04	1.29±2.29*	1.85±3.13**	1.34±2.81*	0.74±1.59*	0.45±1.19**	0.42±0.96**
		(0.87)	(0.81)	(1.09)	(0.85)	(0.91)	(0.77)	(0.93)
Total	Present	28.5±1.51	28.0±6.43	25.2±4.23**	20.1±7.58**	14.7±9.81**	9.55±9.90**	7.26±8.72**
		(28.4)	(28.4)	(27.5)	(25.1)	(21.9)	(16.6)	(11.0)
	Decayed	0.85±1.80	1.58±2.87*	2.22±3.53**	1.40±2.64**	0.88±1.87	0.71±1.79**	0.59±1.37**
		(1.08)	(0.98)	(1.02)	(0.98)	(1.00)	(0.99)	(1.18)

[a]Values are shown as the average ± standard deviation.

Values in parentheses are averages from the National survey conducted in 2011.

*p<.05, **p<.01; significantly different from National survey result (t test). The age group of 18-29 years was compared with that of 20-29 years in the National survey.

Table 3 Number of subjects with a periodontal pocket[a]

	Age group (in years)						
	18-29	30-39	40-49	50-59	60-69	70-79	≥80
Male	2/22 (9.09)	21/48 (43.8)	27/66 (40.9)	56/89 (62.9)	115/202 (56.9)	94/164 (57.3)	21/32 (65.6)
	18.2	26.0	35.3	46.4	59.9	61.8	69.3
Female	4/37 (10.8)	18/100 (18.0)	64/132 (48.5)*	78/184 (42.4)	145/306 (47.4)	62/133 (46.6)	19/32 (59.4)
	11.2	19.5	23.9	38.0	45.5	49.6	55.7
Total	6/53 (11.3)	39/148 (26.4)	91/198 (46.0)*	134/273 (49.1)	260/508 (51.2)	156/297 (52.5)	40/64 (62.5)
	13.7	22.0	28.0	41.3	51.5	55.1	62.0

[a]Data for subjects with at least 1 index tooth in the CPI (n=1547).

Numerator/denominator: number with a periodontal pocket/number of subjects excluding those with no index tooth (percent rate).

Lower number: Percent rate of subjects with a periodontal pocket among those with no index tooth from the National survey in 2011.

*Significantly different (p<.05) as compared with the National survey result (Fisher's exact test).

the group aged over 60 and over, the number of decayed teeth in our subjects was less than the national average.

CPI results showed that the proportion of subjects in the 40s age group with a periodontal pocket (code 3 and 4) was higher in our subjects than in those in the national survey. However, there was no difference between age groups 50 years old and older (Table 3).

2. Experienceswith dental care before and afterthe disaster

For this section, we categorized the subjects aged 18-29 years old and those in their 30s into a single group of less than 40 years old, because no difference was found regarding the responses to the questionnaire between those 2 age groups.

Among our subjects, 357 (17.8% of all) had visited a dental clinic for treatment prior to the disaster. The lowest rate was observed in the age group less than 40 years old (13.8%), while the highest was the 50s group (23.5%). For the 357 subjects, 10.6% did not have care interrupted by the disaster, 53.8% had care interrupted and then resumed, and dental care for 35.6% remained interrupted at the time of our investigation. A chi-squared test results showed that there were significant differences regarding the proportion of subjects whose dental care remained interrupted among the age groups. The proportion with interrupted care was highest in the youngest age group (less than 40 years) and decreased gradually with age until the 60s, then increased again in the 70s and 80s. A multiple comparisons test showed that the proportion of subjects who had interrupted dental care was significantly higher in the youngest age group as compared

Table 4 Experiences with dental care after disaster by age group

	Age group (in years)							
Experiences with dental care	<40	40-49	50-59	60-69	70-79	≥80	Total	*p*-value[e]
Dental care before disaster[a, b]								
Without interruption	4 (13.3)	2 (6.1)	6 (8.7)	16 (13.2)	9 (11.4)	1 (4.0)	38 (10.6)	< 0.001
Once interrupted and resumed	8 (26.7)	12 (36.4)	33 (47.8)	78 (48.5)	49 (62.0)	12 (48.0)	192 (53.8)	
Still interrupted	18 (60.0)*	19 (57.6) [§]	30 (43.5)	27 (22.3)	21 (26.6)	12 (48.0)	127 (35.6)	
Total	30 (100)	33 (100)	69 (100)	121 (100)	79 (100)	25 (100)	357 (100)	
Loss or fructure of denture[a, c]								
No	-	38 (84.4)	107 (95.5)	342 (80.5)	369 (87.4)	105 (86.1)	961 (84.6)	0.054
Yes	-	7 (15.6)	15 (13.4)	83 (19.5)	53 (12.6)	17 (13.9)	175 (15.4)	
Total		45 (100)	122 (100)	425 (100)	422 (100)	122 (100)	1,136 (100)	
Re-restoration or repair of denture[d]								
No	-	4 (57.1)	6 (42.9)	20 (25.6)	10 (20.4)	3 (17.6)	43 (26.1)	0.136
Yes	-	3 (42.9)	8 (57.1)	58 (74.4)	39 (79.6)	14 (82.4)	122 (73.9)	
Total		7(100)	14(100)	78 (100)	49 (100)	17 (100)	165(100)	

[a]Numbers of subjects are shown in respective age groups (percent rate). Subjects with no record were excluded from analysis.

[b]Data for 357 individuals who had visited a dental clinic for treatments before the disaster.

[c]Data for 1136 individuals who had worn a plate denture before the disaster. We excluded the less than 40 years age group from analysis since there was no subject wearing a plate denture.

[d]Data for 165 individuals excluding non-respondents from 175 who had corrupted or lost dentures.

[e]Chi-squared test

*Significantly higher rate than that in 50s and 60s age groups by multiple comparison tests ($p<.01$).

[§]Significantly higher rate than that in 60s age group by multiple comparison test ($p<.01$).

Table 5 Comparison of oral status and experiences with dental care by level of damage

Oral status and experiences with dental care	Damage level			Total	*p*-value
	1 (no damage)	2 (partially destroyed or flooded)	3 (entirely destroyed)		
No. of present teeth[b]	16.2±10.8	15.5±10.4	16.4±10.8	16.1±10.7	0.303
No. of decayed teeth[b]	1.05±2.06	1.00±2.41	1.13±2.36	1.08±2.30	0.565
With a periodontal pocket[c]	179/389 (46.0)	190/372 (51.1)	346/767 (45.1)	715/1528 (46.8)	0.157
Interruption of dental care[d]	30/88 (34.1)	35/94 (37.2)	61/172 (35.5)	126/354 (35.6)	0.906
Lost or fractured denture[e]	36/287 (12.5)	41/290 (14.1)	95/576 (16.5)	172/1159 (14.8)	0.281

[a]Data was obtained from available geographic data.

[b]Average ± standard deviation. The numbers of subjects in the respective damage level groups were as follows; 512 for level 1, 481 for level 2, and 980 for level 3.

[c]Data for subjects with 1 or more CPI index tooth (n=1528). Values indicate number of subjects with a periodontal pocket/all subjects in each damage level group (percentage).

[d]Data for subjects who had visited a dental clinic for treatment before the disaster.Values indicate number of subjects with interrupted care/ number of subjects in damage level group (percentage).

[e]Data for subjects who were wearing a plate denture before disaster and available from geographic data.

to those in the 50s and 60s age groups. In addition, the proportion in the 40s group was significantly higher as compared with the 60s group. On the other hand, there were no significant differences among the age groups in regard to the proportion of subjects who had experienced denture loss or fracture and subsequent re-restoration or repair (Table 4).

3. Comparisons of oral conditions and experiences with dental care based on level of home damage

We compared oral status and experiences with dental care among the 3 groups classified by damage level caused by the disaster (Table 5). There were no differences regarding the numbers of present or decayed teeth. Similarly, the proportions of subjects with periodontal pockets did not differ by damage level. Furthermore, experiences with dental care after the disaster and loss or fracture of denture by the disaster occurred with similar frequencies among the 3 groups.

4. Relationships between experiences with dental care and historical/current oral condition

Next, we examined the relationships between dental care-related experiences and oral health status in subjects 40 years old and older. Chi-squared test results indicated that the proportion of subjects with a history of difficulty with eating was significantly different based on dental care-related experiences. Multiple comparison tests also showed differences between subjects who had not received dental treatment before the disaster and those who had their dental treatments interrupted. Similarly, a history of difficulty with eating was related to experiences with fractured or lost dentures. Subjects with a history of difficulty with eating were more frequently found among those with experiences with fractured or lost dentures as compared to those who did not wear dentures. Furthermore, difficulty with eating was more frequently reported by subjects who had undergone re-restoration or repair of dentures as compared to those without fractured or lost dentures. There was also a relationship between experiences with dental care and history of difficulty with speaking (Table 6).

Table 6 Relationships between experiences with dental care with historical and current oral condition(≥ 40 years old)

Experiences with dental care	Historical oral status[c]						Current oral condition
	Difficulty with eating		Difficulty with speaking		Ashamed to laugh		Average score[d]
	Experienced	Never	Experienced	Never	Experienced	Never	
Interruption of dental care							
Was not receiving care	325 (22.5)	1122 (77.5)	39 (2.7)	1408 (97.3)	29 (11.4)	1418 (4.0)	2.18
No interruption	7 (20.6)	27 (79.4)	1 (2.9)	33 (97.1)	1 (62.0)	33(48.0)	2.26
Interrupted and resumed	74 (40.2)	110 (59.8)	17 (9.2)	167 (90.8)	9(26.6)	175 (48.0)	2.29
Remained interrupted	39 (36.1)	69 (63.9)	7 (6.5)	101 (93.5)	2 (100)	106(100)	2.71
Total	445 (25.1)	1328 (74.9)	64 (3.6)	1709 (96.4)	41 (2.3)	1732 (97.7)	-
p-value	< 0.001		< 0.001		0.103		< 0.001
(No record = 11)[a]							
Lost or fractured denture							
Wearing no denture	140 (21.7)	504 (78.3)	14 (2.2)	630 (97.8)	17 (2.6)	627 (97.4)	2.25
No	232 (24.1)	729 (75.9)	35 (3.6)	926 (96.4)	17 (1.8)	944 (98.2)	2.17
Yes	76 (43.4)	99 (56.6)	15 (8.6)	160 (91.4)	7 (4.0)	168 (96.0)	2.42
Total	448 (25.2)	1332 (74.8)	64 (3.6)	1716 (96.4)	41 (2.3)	1739 (97.7)	-
p-value	< 0.001		< 0.001		0.151		< 0.001
(No record = 4)[a]							
Re-restoration or repair of denture							
Neither fractured nor lost[b]							
No	372 (23.3)	1224 (76.7)	48 (3.0)	1548 (97.0)	34 (2.1)	1562 (97.9)	2.20
Yes	17 (32.1)	36 (67.9)	5 (9.4)	48 (90.6)	3 (5.7)	50 (94.3)	2.28
Total	56 (45.2)	68 (54.8)	11 (8.9)	113 (91.1)	4 (3.2)	120 (96.8)	2.70
p-value	445 (25.1)	1328 (74.9)	48 (3.6)	1709 (96.4)	41 (2.3)	1732 (97.7)	
(No record =11)[a]	<0.001		<0.001	0.190			< 0.001

[a]Subjects with no record were excluded from analyses.

[b]Number including subjects who did not wear a denture.

[c]For comparison, a chi-squared test followed by Ryan's multiple comparison of proportions were used.

[d]For comparisons, ANOVA followed by Sheffe's multiple comparison test were used. *p<.05, **p<.001

On the other hand, history of feeling ashamed to laugh was not related to dental care experience.

Current oral status values assessed by the 4 levels are shown as averages also in Table 6 (higher values indicate worse oral status). Analysis with ANOVA revealed that current oral status differed based on experience with dental care. In findings of multiple comparison tests regarding the interruption of dental treatments, subjects who had dental care remaining interrupted were more conscious of worse oral conditions than all other groups of subjects. In addition, current oral status was significantly worse in subjects with a lost or fractured denture as compared with those whose denture had not been lost or fractured. Furthermore, subjects who did not undergo re-restoration or repair even though their denture was lost or fractured reported worse oral conditions on the day of our investigation as compared to the other subjects.

Ⅳ. Discussion

Our oral examination results revealed that our subjects had more decayed teeth and more

teeth with a periodontal pocket than subjects in the national survey. In addition, many teeth were lost in the higher aged subjects (Tables 2 and 3). Although lower numbers of decayed teeth were found in subjects aged 50 years and older, that was not considered to indicate wellness of their oral condition, as it could also show a low susceptibility to dental caries caused by lack of present teeth. Based on our findings, we concluded that our subjects had worse oral health conditions than the general Japanese population.

On the other hand, our survey revealed that dental and periodontal conditions did not differ with different damage levels (Table 5), which suggests that dental disease status does not rapidly change even after such a disaster, as dental caries and periodontitis are generally chronic conditions.[6-8] Furthermore, Otsuchi Town is located in a remote area of Iwate Prefecture (Figure 1). Previous studies of geographic variations in oral health have shown that the oral status of residents living in rural or remote areas were mostly worse than those of residents living in urban areas.[9-13] Therefore, it was very likely that the oral status of our subjects observed in this study was primarily related to natural oral characteristics present before the disaster, though there could be some influences of the disaster. Nevertheless, the long-term influence of the earthquake and tsunami remain unknown, thus it will be important to continuously observe the oral health status of these subjects in the future.

Our questionnaire survey also revealed that subjects with lost or fractured removable dentures more frequently experienced oral problems such as difficulties with eating and speaking as compared to the other denture wearers (Table 6). Our subjects also had fewer present teeth than the national average (Table 2) and consequently they frequently wore removable dentures, with the proportion of denture wearers in their 40s, 50s, 60s, 70s, and 80s shown to be 13%, 31%, 55%, 74%, and 84%, respectively (data not shown in Results section). Among subjects who live in rural areas and frequently depend on removable dentures for their oral functions, many individuals may be at risk of developing oral problems after such a disaster. On the other hand, in denture wearers who did not lose or fracture their dentures during the disaster, the proportion of those who had experienced oral troubles was not different as compared with non-denture wearers. In addition, current oral status was reported as best by denture wearers without lost or fractured dentures, and worst by those who had lost or fractured dentures (Table 6). These results indicate that denture nonconformance occurred with very low frequency as a result of this large-scale disaster.

Among subjects with lost or fractured removable denture, those with oral trouble underwent re-restoration or repair more frequently than those without such troubles (Table 6). This finding suggests that individuals with high needs for dental care will make an effort to treat their problems even after experiencing a disaster. Also, subjects who underwent re-restoration or repair of their dentures had worse oral conditions as compared to those who did not recieve re-restoration or repair (Table 6). Removable dentures usually require periodic adjustments. Kivovics et al. reported that 87% of new complete dentures required adjustment at least once.[14] Thus, we consider that a lack of dental resources in the disasterareas prevented these subjects from undergoing adequate

adjustments after re-restoration or repair.

Difficulties with eating and speaking were also frequently reported by subjects who had dental care interrupted, includingdenture treatments (Table 6). Hence, for victims who have been receiving dental care, it is important to resume dental care as soon as possible after a disaster, which can be amajorinhibitor of community oral health, since individuals living in fullydeveloped countries generally have ample opportunities to receive dental care. Actually, approximate 18% of all of our subjects had received dental care before the disaster.

As shown in Table 4, in the younger (under 50 years old) and the older ages (70 years or older), the proportion of subjects who received dental care was lower than the middle ages (50-69 years old) after the disaster. As for the younger ages, we speculated that they had no time to receive dental care, as they spent much time in reconstruction of their daily life. As for the elderly groups, the lack of post-disaster dental treatment may have been caused by poor accessibility to dental facilities. Elderly individuals commonly have problems related to proximity and lack of transportation.[15,16] Therefore, it may have been impossible to travel to dental facilities operating in a nearby town, as nearly all public transportation options were lost after the disaster.

Immediately after the disaster, a large number of dentists and dental hygienists, including the present authors, visited shelters to provide dental health care for victims and help prevent deterioration of their oral health.[17] However, such activities have severe limitations of time, manpower, equipment and other resources. As shown in this study, even at 9 months after the disaster, many inhabitants of the disaster area needed dental care service, but were restricted by limited time and transportation.

V. Conclusion

Following a severe disaster, limited dental resources are needed, mainly for local inhabitants whose dental care have been interrupted, or have lost or damaged dentures, as their oral health is likely impaired. In addition, in order to protect the oral health of victims of such a disaster, it is necessary to quickly establish facilities or systems that provide continuous dental care in residential areas.

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