ACP AMERICAN COLLEGE OF PROSTHODONTISTS
Your smile. Our specialty.®

Impact of Loss of Removable Dentures on Oral Health after the Great East Japan Earthquake: A Retrospective Cohort Study

Yukihiro Sato, DDS,[1] Jun Aida, DDS, PhD,[1] Kenji Takeuchi, DDS, PhD,[1,2] Kanade Ito, MS,[1] Shihoko Koyama, DDS,[1] Masako Kakizaki, PhD,[3] Mari Sato, MPHM,[4,5] Ken Osaka, MD, PhD,[1,6] & Ichiro Tsuji, MD, PhD[3,4]

[1]Department of International and Community Oral Health, Tohoku University Graduate School of Dentistry, Sendai, Japan
[2]Section of Preventive and Public Health Dentistry, Division of Oral Health, Growth and Development, Faculty of Dental Science, Kyushu University, Fukuoka, Japan
[3]Division of Epidemiology, Department of Public Health and Forensic Medicine, Tohoku University Graduate School of Medicine, Sendai, Japan
[4]Center for Community Health, Tohoku University Graduate School of Medicine, Sendai, Japan
[5]Department of Women's Health Nursing, Tohoku University Graduate School of Medicine, Sendai, Japan
[6]Tohoku University International Research Institute of Disaster Science, Sendai, Japan

Keywords
Disasters; dental care; public health; quality of life; tsunamis; disaster medicine.

Correspondence
Yukihiro Sato, Department of International and Community Oral Health, Tohoku University Graduate School of Dentistry, 4–1, Seiryo-machi, Aoba-ku, Sendai, Miyagi, 980-8575, Japan.
E-mail: yukisatou-thk@umin.ac.jp

This study was supported by Tohoku University Graduate School of Dentistry and Center for Community Health, Tohoku University Graduate School of Medicine, and also by Health Labour Sciences Research Grants, H24-Kenki-Shitei-002, H25-Kenki-Shitei-002 (Fukko), from the Japanese Ministry of Health, Labour and Welfare.

The authors declare no potential conflicts of interest with respect to the authorship and/or publication of this article.

Accepted May 25, 2014

doi: 10.1111/jopr.12210

Abstract

Purpose: The Great East Japan Earthquake in March 2011 destroyed many communities, and as a result many older victims lost their removable dentures. No previous studies have documented the prevalence of denture loss after a natural disaster or examined its negative impact. Therefore, investigation of the consequences of such a disaster on oral health is of major importance from a public health viewpoint.
Materials and Methods: Three to five months after the disaster, questionnaire surveys were conducted in two coastal towns, Ogatu and Oshika, located in the area of Ishinomaki city, Miyagi prefecture. Among the survey participants, 715 individuals had used one or more removable dentures before the disaster, and these comprised the population analyzed. The effect of denture loss on oral health-related quality life (OHRQoL) was examined by a modified Poisson regression approach with adjustment for sex, age, subjective household economic status, dental caries, tooth mobility, psychological distress (K6), access to a dental clinic, physical activity, and town of residence.
Results: There were 123 (17.2%) participants who had lost their dentures. In comparison with participants who had not lost their dentures, those lacking dentures showed a significantly higher relative risk for eating difficulties (RR = 2.65, 95%CI = 1.90–3.69), speech problems (RR = 4.37, 95%CI = 2.46–7.76), embarrassment upon smiling, laughing, or showing their teeth (RR = 5.32, 95%CI = 2.34–12.1), emotional distress (RR = 2.38, 95%CI = 1.41–4.03), and problems related to social interaction (RR = 6.97, 95%CI = 1.75–27.7).
Conclusions: Denture loss appeared to impair eating and speaking ability, thus discouraging communication with others. Public health intervention after major natural disasters should include dental care.

It is widely recognized that natural disasters cause major public health problems.[1] In 2010 alone, there were 640 such disasters worldwide, causing around 304,476 deaths.[2] The magnitude 9.0 Great East Japan Earthquake and tsunami that occurred on March 11, 2011, was the greatest disaster ever recorded in Japan (reported April 24, 2011; Japan Meteorological Agency). The disaster killed 15,873 (with an additional 2744 people reported missing and 6111 injured). Building damage included complete destruction of 129,622 properties, partial destruction of 266,392, and complete or partial destruction by fire of 279 (reported November 14, 2012; National Police Agency of Japan).

Disasters cause fatalities[2-4] and affect the physical and mental health of populations.[5-10] The majority of studies conducted after disasters have focused on these health aspects, whereas little attention has been paid to oral health.

The 2011 tsunami destroyed houses, and as a result many older victims lost their removable dentures. No previous study has examined the negative impact of such disaster-related

denture loss, despite its importance from a public health perspective. In addition, although many studies have evaluated the positive effects of dentures on oral health,[11,12] it is not ethically feasible to investigate the impact of denture loss by asking patients to cease using them. Therefore, examination of the impact of denture loss resulting from a disaster presents an important opportunity to conduct a "natural experiment." The aim of this study was to examine the association between denture loss and oral health-related quality life (OHRQoL) after the Great East Japan Earthquake.

Materials and methods

Study sample

This epidemiological retrospective cohort study was conducted during a 9-week period between June and August 2011, 3 to 5 months after the disaster. Health examinations including dental checkups and questionnaire surveys were conducted in two coastal towns, Ogatu and Oshika, located in the area of Ishinomaki City, Miyagi Prefecture. Because exposure (denture loss) preceded the outcome measurement (OHRQoL), this study was considered to be a cohort study. In addition, it was considered a natural experiment study. There was a low possibility that individuals who had lost their dentures would have tended to have poor OHRQoL at the baseline. Among the 3009 residents aged 18 years or older, 1399 participated in our study (response rate = 46.5%). Among them, 758 had used one or more removable dentures before the disaster. After excluding data with missing variables, data on 715 individuals were included in the analysis.

Outcome variables

Self-reported OHRQoL at 3 to 5 months after the disaster (baseline) was used as the outcome. It was assessed using five questions modified from the English version of the Oral Impacts on Daily Performance questionnaire[13] used in longitudinal studies of aging[14] and translated into Japanese. The questions asked participants about "difficulty eating food," "difficulty speaking clearly," "problems with smiling, laughing, and showing teeth without embarrassment," "problems with emotional stability, for example, becoming more easily upset than usual," and "problems enjoying the company of other people such as family, friends, or neighbors." The questions in the OHRQoL questionnaire required dichotomous (yes/no) answers.

Main predictor

The study participants were individuals who had been using removable dentures before the Great East Japan Earthquake. We asked whether they had lost or sustained damage to their dentures. We then categorized them into two groups: (1) those who had lost their dentures in the tsunami and (2) those who had not lost their dentures.

Covariates

Sex, age, subjective household economic status, dental caries, tooth mobility, psychological distress, access to a dental clinic, physical activity, and town of residence were used as covariates. Age was divided into quartiles: 61.1 years or younger, 61.2 to 69.2 years, 69.3 to 76.4 years, and 76.5 years or older. Subjective household economic status was obtained using the following self-reported question: "How do you feel about your current household economy?" The response alternatives were poorest, poorer, poor, or fair. Presence of dental caries and tooth mobility were ascertained at dental checkups by dentists. If a participant had at least one decayed tooth or one loose tooth, this fact was recorded. Tooth mobility was coded in accordance with the Miller Classification of Tooth Mobility: normal mobility,[15] class I (slight mobility), class II (moderate mobility), or class III (severe mobility).

Because some disaster victims had severe psychological distress, mental depression might have affected their responses to the OHRQoL questions. Therefore, as a confounder, psychological distress assessed by the K6 scale[16] was included in the model. We used a K6 score cutoff of 13 points as the definition for serious psychological distress.[16] We used the Japanese version of K6, which had been developed through a standard back-translation procedure and has been validated.[17]

Access to a dental clinic was assessed using the question: "Have you stopped going to a dental clinic since the earthquake?" The response alternatives were "have not attended a dental clinic," "have attended a dental clinic," "have stopped going to a dental clinic, but attended another dental clinic," "initially stopped going to a dental clinic, but attended the same dental clinic later," and "have stopped going to a dental clinic since the disaster." Physical activity was recorded using the self-reported question: "How long do you spend walking each day?" The response alternatives were: more than an hour, half an hour to an hour, or less than half an hour. The town of residence was categorized as Ogatsu or Oshika and included in the analysis.

Statistical analysis

We applied the chi-squared test for cross-tabulation, and *t*-test was used for examining the significance of differences in mean age among the groups. Because the prevalence of the participants with poorer OHRQoL outcomes was high, we estimated the relative risk rather than the odds ratio.[18] A modified Poisson regression approach was used to estimate the relative risk of denture loss for poorer OHRQoL.[19] Separate models were built for five OHRQoL outcome variables. Age, sex, subjective household economic status, dental caries, tooth mobility, psychological distress (K6), access to a dental clinic, physical activity, and town of residence were included in the models as covariates. Statistical analyses for descriptive statistics and a modified Poisson regression approach were conducted using IBM SPSS v.20.0.0 J for Windows and STATA SE v.12.1, respectively.

Ethical considerations

The study protocol was reviewed and approved by the Ethics Committee of Tohoku University Graduate School of Medicine. The questionnaires were given to all participants explaining the aims of the study. We obtained written informed consent from all participants.

Table 1 Differences in sociodemographic variables and OHRQoL by denture status (N = 715)

		Denture loss (%)	No denture loss (%)	*P*-value
Sex	Male	59(48.0)	271(45.8)	0.691
	Female	64(52.0)	321(54.2)	
Town of residence	Ogatu	63(51.2)	273(46.1)	0.322
	Oshika	60(48.8)	319(53.9)	
SES	Poorest	17(13.8)	73(12.3)	0.615
	Poorer	22(17.9)	119(20.1)	
	Poor	34(27.6)	136(23.0)	
	Fair	50(40.7)	264(44.6)	
K6	No distress	114(92.7)	548(92.6)	1.00
	Serious psychological distress	9(7.32)	44(7.4)	
Walking time	More than an hour	36(29.3)	178(30.1)	0.029
	Half an hour to an hour	55(44.7)	197(33.3)	
	Less than half an hour	32(26.0)	217(36.7)	
Have you stopped going to a dental clinic since the earthquake?	Have not attended a dental clinic	68(55.3)	447(75.5)	<0.001
	Have attended a dental clinic	3(2.4)	14(2.4)	
	Have stopped going to a dental clinic, but attended another dental clinic	17(13.8)	23(3.9)	
	Initially stopped going to a dental clinic, but attended the same dental clinic later	17(13.8)	27(4.6)	
	Have stopped going to a dental clinic since the disaster	18(14.6)	81(13.7)	
Dental caries	No caries	92(74.8)	441(74.5)	1.00
	Having at least one decayed tooth	31(25.2)	151(25.5)	
Mobility	Normal	91(74.0)	443(74.8)	0.756
	Class I (slight)	23(18.7)	95(16.0)	
	Class II (moderate)	7(5.7)	35(5.9)	
	Class III (severe)	2(1.6)	19(3.2)	
Difficulty eating food	No	76(61.8)	517(87.3)	<0.001
	Yes	47(38.2)	75(12.7)	
Difficulty speaking clearly	No	97(78.9)	569(96.1)	<0.001
	Yes	26(21.1)	23(3.9)	
Problems with smiling, laughing, and showing teeth without embarrassment	No	109(88.6)	583(98.5)	<0.001
	Yes	14(11.4)	9(1.5)	
Problems with emotional stability, for example, becoming more easily upset than usual	No	99(80.5)	553(93.4)	<0.001
	Yes	24(19.5)	39(6.6)	
Problems enjoying the company of other people such as family, friends, or neighbors	No	117(95.1)	587(99.2)	0.005
	Yes	6(4.9)	5(0.8)	
Age	Mean value	67.22	67.42	0.592
	SD	9.59	12.959	

Results

Seven hundred fifteen individuals (average age: 67.4 years [SD = 12.4], men: 45.2%, women: 53.8%) had used at least one denture before the disaster. Among these 715, 17.2% (N = 123, men: 48.0%, women: 52.0%; average age 67.2 years, SD = 9.6) had lost their dentures in the disaster.

Table 1 shows the differences in sociodemographic variables and OHRQoL according to denture status. There were no significant differences in age, sex, subjective household economic status, dental caries, tooth mobility, psychological distress (K6), and town of residence between the participants who had lost their dentures and those who had not; however, there were significant differences in access to a dental clinic and physical activity between the participants who had lost their dentures and those who had not. Those who had lost their dentures showed significantly poorer OHRQoL.

Table 2 shows the relative risk of denture loss for poorer OHRQoL outcomes. A modified Poisson regression approach was performed for each of the OHRQoL outcomes. We built age- and sex-adjusted models and fully adjusted models that included sex, age, subjective household economic status,

Table 2 Relative risk of denture loss for poorer OHRQoL outcomes (N = 715)

	Age- and sex-adjusted models			Fully adjusted models*		
Outcome variables	Relative risk for denture loss (reference = no denture loss)	95%CI	*P*-value	Relative risk for denture Rloss (reference = no denture loss)	95%CI	*P*-value
Difficulty eating food	2.99	2.19–4.10	<0.001	2.65	1.90–3.69	<0.001
Difficulty speaking clearly	5.38	3.15–9.19	<0.001	4.37	2.46–7.76	<0.001
Problems with smiling, laughing, and showing teeth without embarrassment	7.49	3.38–16.6	<0.001	5.32	2.34–12.1	<0.001
Problems with emotional stability, for example, becoming more easily upset than usual	2.94	1.83–4.72	<0.001	2.38	1.41–4.03	0.001
Problems enjoying the company of other people such as family, friends, or neighbors	5.78	1.79–18.6	0.003	6.97	1.75–27.7	0.006

*Adjusted for sex, age, subjective household economic status, dental caries, tooth mobility, psychological distress (K6), access to a dental clinic, physical activity, and town of residence.

dental caries, tooth mobility, psychological distress (K6), access to a dental clinic, physical activity, and town of residence. In comparison with participants who had not lost their dentures, those who had lost their dentures showed a significantly higher relative risk for difficulty eating food (RR = 2.65, 95%CI = 1.90–3.69), difficulty speaking clearly (RR = 4.37, 95%CI = 2.46–7.76), problems with smiling, laughing, and showing teeth without embarrassment (RR = 5.32, 95%CI = 2.34–12.1), problems with emotional stability, for example, becoming more easily upset than usual (RR = 2.38, 95%CI = 1.41–4.03), and problems enjoying the company of other people such as family, friends, or neighbors (RR = 6.97, 95%CI = 1.75–27.7).

Discussion

This study investigated the prevalence of denture loss in the Great East Japan Earthquake, and the effect of denture loss on OHRQoL. Among the 715 participants who had used at least one denture before the disaster, 17.2% (N = 123) were deprived of their dentures by the tsunami. The individuals who had lost their dentures reported significantly poorer OHRQoL. Denture loss caused difficulties with eating, speaking, smiling, laughing, and showing teeth, emotional stability, and social interaction. Because the total number of disaster victims was huge, the impact of denture loss was important to public health.

Disasters cause health problems or death.[2-6,8-10] The majority of studies conducted after disasters have focused on mental health. A relatively small number of studies have focused on physical health problems, and even fewer have addressed oral health.[20] Those studies suggested an association between disasters and deterioration of oral health; for example, there was a significant increase of periodontal disease after the Wenchuan Southwest China earthquake.[21] To our knowledge, no previous studies have investigated the incidence and consequences of denture loss due to natural disasters. Previous studies have suggested the possibility that denture use improves health, such as oral function, nutritional intake, communication,[11,12,22] and static balance;[23] and reduces the risks of falls,[24] dementia,[25] and mortality,[26] thus underlining the importance of dental care after disasters.

Dentists can play an important role in disaster response through a wide range of activities, as they are: (a) experts in barrier techniques and infection control; (b) trained and skilled in administering drugs by injection; (c) skilled in placing sutures and controlling bleeding; (d) able to participate in interdisciplinary professional groups; and (e) adept at managing uncomfortable patients.[27] In addition, dentists can also contribute to identification of human remains after a disaster.[28] However, dentists are not sufficiently educated in dealing with disaster events.[29] This study suggested the importance of management of patients who have lost dentures as a result of a natural disaster. After a major disaster, dentists should participate in not only disaster victim identification and oral hygiene intervention, but also dental care including the reproduction of lost dentures.

Some strengths and limitations of this study need to be recognized. This study was the first to have investigated denture loss after a major disaster. In addition, the disaster offered an opportunity to study the effects of denture loss on OHRQoL as a natural experiment. One study limitation was that measurement of OHRQoL was not verified in Japanese. Second, we did not consider whether some victims had received emergency dental care services; however, this would have attenuated the association between denture loss and OHRQoL. If we had been able to adequately consider the effects of emergency dental care, the present results would have been strengthened.

Conclusion

Denture loss due to a major natural disaster was shown to compromise eating and speaking ability and to discourage individuals from communicating with others. Public health

interventions after major disasters should include dental care.

References

1. Noji EK: Public health in the aftermath of disasters. BMJ 2005;330:1379-1381
2. Knight L: World Disasters Report. Geneva, International Federation of Red Cross and Red Crescent Societies, 2011.
3. Center for Research on the Epidemiology of Disasters: EM-DAT: The OFDA/CRED International Disaster Database. Brussels, Université Catholique de Louvain, 2012, http://www.emdat.be, Accessed January 7, 2014
4. Pradhan EK, West KP, Jr., Katz J, et al: Risk of flood-related mortality in Nepal. Disasters 2007;31:57-70
5. Hussain A, Weisaeth L, Heir T: Psychiatric disorders and functional impairment among disaster victims after exposure to a natural disaster: a population based study. J Affect Disord 2011;128:135-141
6. Neria Y, Nandi A, Galea S: Post-traumatic stress disorder following disasters: a systematic review. Psychol Med 2008;38:467-480
7. Reacher M, McKenzie K, Lane C, et al: Health impacts of flooding in Lewes: a comparison of reported gastrointestinal and other illness and mental health in flooded and non-flooded households. Commun Dis Public Health 2004;7:39-46
8. Thienkrua W, Cardozo BL, Chakkraband ML, et al: Symptoms of posttraumatic stress disorder and depression among children in tsunami-affected areas in southern Thailand. JAMA 2006;296:549-559
9. van Griensven F, Chakkraband ML, Thienkrua W, et al: Mental health problems among adults in tsunami-affected areas in southern Thailand. JAMA 2006;296:537-548
10. Yzermans CJ, Donker GA, Kerssens JJ, et al: Health problems of victims before and after disaster: a longitudinal study in general practice. Int J Epidemiol 2005;34:820-826
11. Goiato MC, Bannwart LC, Moreno A, et al: Quality of life and stimulus perception in patients' rehabilitated with complete denture. J Oral Rehabil 2012;39:438-445
12. Ellis JS, Pelekis ND, Thomason JM: Conventional rehabilitation of edentulous patients: the impact on oral health-related quality of life and patient satisfaction. J Prosthodont 2007;16: 37-42
13. Tsakos G, Marcenes W, Sheiham A: Evaluation of a modified version of the index of Oral Impacts On Daily Performances (OIDP) in elderly populations in two European countries. Gerodontology 2001;18:121-130
14. Tsakos G, Demakakos P, Breeze E, et al: Social gradients in oral health in older adults: findings from the English longitudinal survey of aging. Am J Public Health 2011;101:1892-1899
15. Laster L, Laudenbach KW, Stoller NH: An evaluation of clinical tooth mobility measurements. J Periodontol 1975;46:603-607
16. Kessler RC, Andrews G, Colpe LJ, et al: Short screening scales to monitor population prevalences and trends in non-specific psychological distress. Psychol Med 2002;32:959-976
17. Furukawa TA, Kawakami N, Saitoh M, et al: The performance of the Japanese version of the K6 and K10 in the World Mental Health Survey Japan. Int J Methods Psychiatr Res 2008;17: 152-158
18. Barros AJ, Hirakata VN: Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. BMC Med Res Methodol 2003;3:21
19. Zou G: A modified Poisson regression approach to prospective studies with binary data. Am J Epidemiol 2004;159:702-706
20. Mosca NG, Finn E, Joskow R: Dental care as a vital service response for disaster victims. J Health Care Poor Underserved 2007;18:262-270
21. Liu D, Hu D, Li X, et al: Periodontitis in 65–74-year-old victims in Wenchuan, China post-earthquake: implications for service provision. Int Dent J 2010;60:161-168
22. Stober T, Danner D, Lehmann F, et al: Association between patient satisfaction with complete dentures and oral health-related quality of life: two-year longitudinal assessment. Clin Oral Investig 2012;16:313-318
23. Moriya S, Notani K, Miura H, et al: Relationship between masticatory ability and physical performance in community-dwelling edentulous older adults wearing complete dentures. Gerodontology 2012. doi: 10.1111/ger.12029. [Epub ahead of print]
24. Yamamoto T, Kondo K, Misawa J, et al: Dental status and incident falls among older Japanese: a prospective cohort study. BMJ Open 2012. doi: 10.1136/bmjopen-2012-001262
25. Yamamoto T, Kondo K, Hirai H, et al: Association between self-reported dental health status and onset of dementia: a 4-year prospective cohort study of older Japanese adults from the Aichi Gerontological Evaluation Study (AGES) Project. Psychosom Med 2012;74:241-248
26. Fukai K, Takiguchi T, Ando Y, et al: Mortality rates of community-residing adults with and without dentures. Geriatr Gerontol Int 2008;8:152-159
27. More FG, Phelan J, Boylan R, et al: Predoctoral dental school curriculum for catastrophe preparedness. J Dent Educ 2004;68:851-858
28. Pretty IA, Sweet D: A look at forensic dentistry – Part 1: the role of teeth in the determination of human identity. Brit Dent J 2001;190:359-366
29. Colvard MD, Lampiris LN, Cordell GA, et al: The dental emergency responder: expanding the scope of dental practice. J Am Dent Assoc 2006;137:468-473