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Using patient self-report data to evaluate orofacial surgical outcomes

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Abstract – *Objectives:* This study analyzes results of 336 patients treated for mandible fractures at King/Drew Medical Center in South Central Los Angeles, California from August 1996 to December 2001. Subjects were enrolled in a prospective study to evaluate the association between patient's subjective evaluation and objective clinical evaluations on three surgical outcome measures following orofacial surgery. *Methods:* Subjects were assessed at four time periods – hospital discharge, 10 days post-discharge, 1 month post-discharge and 6 months post-discharge. Three outcome measures were utilized to represent perceived health and oral health-related quality of life – General Oral Health Assessment Index (GOHAI); Mental Health Inventory (MHI-5); and a single-item self-reported health status measure. *Results:* GOHAI scores at 1 month (mean = 31.5, SD = 9.5) were not substantially higher than at 10 days (mean = 28.6, SD = 8.8), but scores did improve substantially by 6 months (mean = 42.6, SD = 10.6). Mean mental health scores ranged from 17.7 at 10 days to 18.0 at 1 month and 18.6 at 6 months. Mean self-reported health status score were approximately 2.2 at all recalls, describing health as 'good.' A longitudinal growth curve analysis of GOHAI scores over four time periods indicated a significantly higher average intercept for the maxillomandibular fixation (MMF) treatment group (29.67) than in the rigid internal fixation (RIF) treatment group (25.38). Meanwhile, the increase in GOHAI scores over time was significantly greater in the RIF group than in the MMF group, resulting in scores being comparable between groups after 6 months. *Conclusions:* By implication, patients with MMF self-report fewer problems in the early days after placement of the intra-arch wire compared with patients with RIF.

Key words: minority; oral health; oral surgery; self-reported health

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The literature documents a variety of clinical problems associated with facial injury including infection, swelling, limitation of mouth opening, nerve deficits, malocclusion, and fracture nonunion (1–9). While many are transient conditions, some can result in permanent impairment affecting overall quality of life. Important as these problems are, they define surgical outcomes entirely from the clinician's perspective without taking into account the patient's viewpoint. Increasingly, clinicians and researchers have come to view a broader construct of health encompassing the patient perspective as an equally critical element when testing the success of surgical treatment.

Health-related quality of life has been recommended as a construct that facilitates study of the impact of disease on a person's life. Health-related quality of life is a multidimensional concept that incorporates health perceptions, perceptions of actual or potential health, and/or disability (10, 11). Recent studies indicate that oral disease has a negative impact on social, psychological and physical health and functioning (12–14). For example, Reisine et al. (15) reported that the severity of

dental pain was associated with increased interference with functioning and decreased well-being. Gift and Redford (16) noted that oral disease can affect quality of life and 'it is often correlated with increased stays in bed, decreased socialization, social withdrawal, lack of motivation and less interest in eating.'

The term 'oral health-related quality of life' derives its meaning from viewing the oral cavity as a distinct outcome domain, gauging the impact of the oral cavity on the rest of the body, and evaluating the effects of systemic health and health-related quality of life on the oral cavity and oral health-related quality of life (17). Considering the oral cavity as an outcome domain, one takes into account the symptoms and functional complaints expressed by individuals following maxillofacial surgery. As an example of an impact of the oral cavity on systemic health, Shepherd (18) emphasized the need to study long-term sequelae and frequent psychological problems experienced by patients with facial fractures, drawing on their reports of substantial levels of anxiety and depression among patients up to 3 months following injuries. Leathers et al. (19) reported a high incidence of interpersonal violence associated with mandible fractures that may be associated with psychological problems.

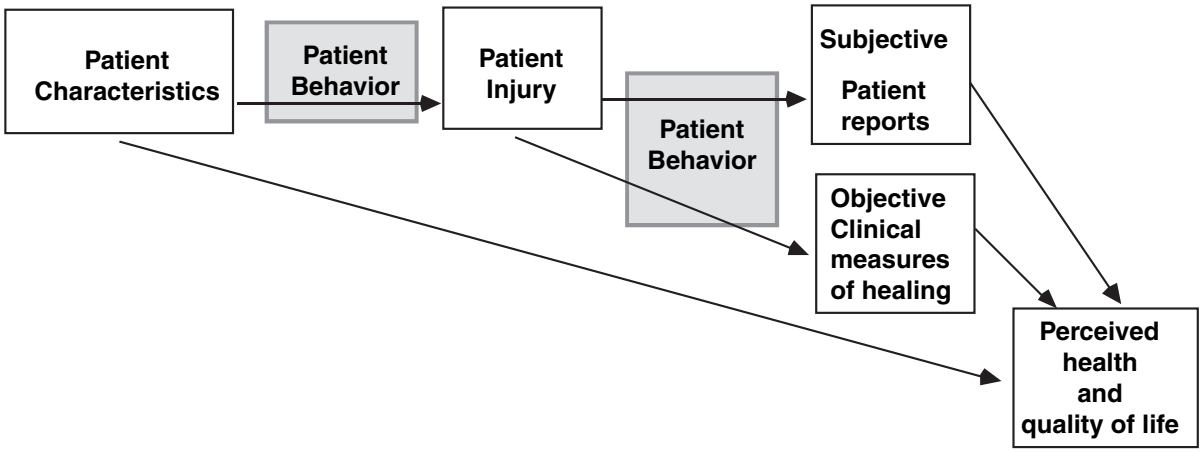
A variety of subjective functional problems and symptoms from the patient's perspective are critical to measuring successful surgical outcomes. Additionally, one must consider objective measures of success or failure, such as fracture nonunion, infection, or trismus. These endpoints include lack of residual pain, ability to speak and chew normally, and psychosocial issues such as esthetics and concerns about one's oral health. In a recent study of the impact of surgical removal of third molars on patients' perceptions (20) that included 19 patients aged 18–25 years, reporting of functional limitations including pain, chewing, bad taste/breath, food impaction, and swelling were very high immediately after surgery.

It has become a standard rule of practice that no single treatment outcome is sufficient because of the multiple perspectives of the patient, the clinician and, in some cases the society (21). We conducted this analysis to evaluate the appropriateness of a model of oral health-related quality of life that incorporates both subjective and objective perspectives of the patient and the clinician in considering the impact of orofacial injury. Representing the patient's viewpoint are the patient's subjective oral health perceptions and functional limitations. Physical function is reported either by the patient or the clinician. The literature notes substantial discrepancies between the patients' perception and the clinicians' evaluation of surgical outcomes (22). For this analysis, we chose to examine the physical functioning outcomes reported by the patient. From the clinician's perspective, we incorporated both the physical description of the injury and clinical evaluation of healing. Finally, the individual's psychological health and perceived health are reported by the patient. Thus, as depicted in Fig. 1, perceived health and quality of life are determined by a number of factors, including subjective patient reports, and clinically evaluated measures of healing. One of the central aims of this study was to examine the interplay among patient characteristics, injury characteristics, patient reports on oral health function, and three outcome measures reflecting quality of life. Another important aim of the study was to compare patterns of quality-of-life outcomes between patients treated with maxillomandibular fixation (MMF) and those treated with rigid internal fixation (RIF). In the study, MMF was assigned to individuals with mandible displacement <2 mm, and RIF was assigned to individuals with mandible displacement >4 mm, and patients were randomized between the two alternatives if the mandible displacement was between 2 and 4 mm, with the attending clinician maintaining the prerogative to exercise clinical judgment in all cases.

Methods

This study analyzes the results of 336 patients treated for mandible fractures at the Department of Oral and Maxillofacial Surgery at King/Drew Medical Center in South Central Los Angeles, California between August 1996 and December 2001. Subjects were enrolled in a prospective study to evaluate the impact of orofacial injury. Inclusion criteria included having a fractured mandible, being ≥18 years of age, not being pregnant, speaking English or Spanish, and being available for follow-up for a 1-year time period. Subjects were enrolled at the time of hospital admission and informed consent was obtained.

Clinical condition and fracture severity were assessed through clinical and radiographic examination. Clinical evaluations were conducted by residents and surgical attendings in accordance



Variables representing each block

Age Sex Ethnic status	Number of fractures Bony displacement Teeth extracted	Subjective • # of patient complaints Clinical Measures • Maximal interincisal opening • Motor deficit • Burning, tingling, pain • Sensory deficit	General Oral Health Assessment Index (12-item) Mental Health Inventory (5-item) Self-rated Health Status

Fig. 1. Conceptual model and variables associated with perceived health and quality of life.

with a written clinical protocol. Subject interviews were conducted by two trained bilingual staff research associates. All data sheets were evaluated by one of the two faculty oral surgeons and accuracy was confirmed.

To assess the impact of the injury and recovery over time, subjects were assessed at – discharge from King/Drew Medical Center, 10 days post-discharge (recall 1), 1 month post-discharge (recall 2) and 6 months post-discharge (recall 3). Most subjects with minor injuries were discharged on the same day as their admission. For others, discharge occurred approximately a week to 10 days later, when the patient was judged to have stabilized medically. For this study, we considered outcomes at recall 1, recall 2 and recall 3, with the 10-day and 1-month measures analyzed as separate outcomes to summarize quality of life in the immediate healing period and the entire set of outcomes (discharge, 10 days post-discharge, 1 month post-discharge, 6 months post-discharge) analyzed together to characterize long-term trends.

Three outcome measures were utilized to represent perceived health and oral health-related quality of life. The General Oral Health Assessment Index (GOHAI) is a 12-item index summarized by two factors: a 'physical worry' factor, comprised of items on worry or concern about one's oral health, use of pain medication, problems with eating, and esthetics; and a 'social' factor, comprising items regarding limitation of social contacts, problems with speaking, and discomfort in eating with others (23–25). Emotional health was assessed using the Mental Health Inventory (MHI-5), a five-item query about feeling down in the dumps, feeling calm and peaceful, feeling blue, feeling happy, and being a nervous person. This measure, originally proposed by Berwick (26), and later utilized in the Medical Outcome Study (27) contains five items, each of which allows five possible responses (Extremely, Quite a bit, Moderately, A little bit, and Not at all). The MHI-5 was tested in the same sample and determined to be correlated with but distinct from the GOHAI (25). Supplementing the GOHAI and MHI-F, our third outcome measure was a single item characterizing self-reported health status with five response categories ranging from Excellent, Very Good, Good, Fair or

Poor to the question: 'How would you rate your health?' (see Fig. 1).

Independent variables included patient's sociodemographic characteristics, clinical descriptors of the injury, subjective patient reports, and clinical measures of healing. As shown in Fig. 1, patient's sociodemographic characteristics included patient age, gender, ethnic status, and education. Information regarding the injury included the treatment group, the number of fractures (1 versus 2 or more), interfragmentary displacement (in millimeters), and number of teeth extracted during surgery. Patient subjective reports included reports of swelling, pain, bad taste, limitations of opening, painful teeth, irritation by wire used to immobilize the teeth/jaw, a foreign body sensation, and feelings of a bad bite (malocclusion). A summary 'Number of Patient Complaints' variable was constructed by counting the affirmative responses. Clinical evaluation of the resulting problems or complications included: maximal incisal opening, motor and sensory deficits, as well as an assessment of burning, tingling, or pain of the lip and face. All information regarding the injury was recorded at each of the recall time periods.

Data analysis

The GOHAI and the MHI-5 were constructed as simple summed scores after reversing the coding of certain items to ensure a higher score indicates more positive health. Possible scores for the GOHAI were from 12 to 60, and possible scores for the MHI-5 range from 5 to 25. Using factor analysis with questionnaire item measures as input, we explored whether GOHAI, MHI-5, and self-reported health status could be reduced to a smaller set of meaningful factors, but we found no compelling basis to do so. Next, we used analysis of variance to examine the association between patient characteristics and mean GOHAI, MHI-5 and self-reported health status at 10 days and 1 month post-discharge to select the significant variables for further consideration.

To address incomplete data arising from some patients not being available for interviews at various recall time points, we used an analytical strategy based on multiple imputation (28), aiming to take advantage of information drawn from observed associations between variables while accurately reflecting uncertainty about items not present. Specifically, we used the NORM software package (29) available at http://www.stat.psu.edu/ jls to impute values under a multivariate model encompassing not only all of the variables used in the present analysis but also additional variables measuring psychological outcomes that were judged to be potentially associated with the variables investigated here. In all, 106 variables were included in the imputation model; to stabilize estimation in such a high-dimensional setting, we used the ridge-prior approach (29) designed expressly for this purpose. In this analysis, no distinction was made among possible reasons for missing values. After producing five imputed datasets, we ran our regression models on each, combining the results into an overall inference using the framework of Rubin (28), involving averaging point estimates of regression coefficients and combining the average within-imputation variability with an estimate of between-imputation variability. We report results from these multiple-imputation analyses.

We constructed multiple regression models for all three outcome measures to identify important predictors (sociodemographic characteristics, fracture characteristics, subjective patient complaints, and objective clinical healing measures) of outcomes at 10 days and 1 month, which represent the immediate healing period. As a final analysis, we used two-stage hierarchical linear modeling to study the GOHAI trend over four time points (discharge, 10 days post-discharge, 1 month post-discharge and 6 months post-discharge). For this linear growth model, patient-specific intercepts and slopes in GOHAI scores were treated as random effects varying about treatment-group mean values after transforming the time scale using a $\log(1 + t)$ transformation, which was done to avoid attaching excessive weight to the 6-month outcome in the model fitting.

Results

The sample consisted of men and women who sought care at King-Drew Medical Center for a facial injury resulting in a mandible fracture. Approximately 70% of the patients were <40 years of age and were predominantly male (89%), predominantly African–American (73%) or Hispanic (22%), and unemployed (68%) (see Table 1). Over 35% had not completed high school education.

Scores for the GOHAI ranged from 12 to 51 at 10 days post-discharge, from 13 to 58 at 1 month post-discharge, and from 13 to 60 at 6 months

Table 1. Patient (sociodemographic) characteristics ($n = 336$)

	n (10 day)	Percentage
Age (years)		
18–29	119	35
30–39	120	36
40+	97	29
Sex		
Male	299	89
Female	37	11
Ethnic/racial background		
African–American	244	73
Hispanic	74	22
Other	18	5
Employment status		
Employed (full or part time)	106	32
Not employed	230	68
Treatment		
MMF	207	62
RIF	129	38
Education		
Less than high school	130	39
High school or above	206	61

post-discharge (Table 2). Mean scores for the GOHAI were 28.6 (SD = 8.80), 31.5 (SD = 9.49), and 42.6 (SD = 10.59) across the three time periods, respectively. For the MHI-5, scores ranged from 5 to 25 at 10 days post-discharge, 6 to 25 at 1 month post-discharge, and 6 to 25 at 6 months post-discharge. Across the three time periods, mean scores of 17.7, 18.0, and 18.6 were reported, respectively. The mean patient self-rating of health score was approximately 2.2 at all recalls, describing health as 'good.' Bivariate analysis demonstrated that each of the three outcome measures had significant associations with sociodemographic variables at earlier recall visits. Significant gender differences were found, with males having higher GOHAI and MHI-5 scores at 10 days and 1 month post-discharge. Moreover, at 10 days and 1 month post-discharge, the younger age category (18–29 years) had higher MHI-5 scores compared with the 40+ age group. At 1 month, but not at other times, the employed patients had higher MHI-5 scores. For self-reported health status, significant age differences were found in both recalls. The younger age group had higher self-reported health status. Although patient characteristics were related to the MHI-5, none of the fracture characteristics or patient complaints had significant associations with MHI-5 scores.

Table 2 presents the response frequencies for the three outcome measures across the follow-up time points. Considering the self-reported physical and psychosocial limitation items included in the GOHAI, none of the responses exceeded 87 % for occurring 'Always' or 'Often'. The three items reported most frequently during the immediate healing period covered by the 10-day and 1-month interviews all dealt with eating problems, limiting kinds or amounts of food, having trouble biting or chewing, and having discomfort while eating. These had notably declined by 6 months post-discharge. The least frequently mentioned items during immediate healing were primarily psychosocial: limiting contacts with people because of the condition of teeth or jaws, feeling nervous or self-conscious because of problems with teeth or jaws, feeling uncomfortable eating in front of people because of problems with teeth or jaws and being bothered by sensitive teeth or gums. Difficulty swallowing continued to be problematic at all three time periods. For the MHI-5, the conditions reported most frequently were positive conditions, feeling calm and peaceful, and happy. The single-item rating of health suggested a small difference between 10 days and 1 month post-discharge. Ratings of excellent or very good were reported by 31% of patients of 10 days, 29% at 1 month, and 37% at 6 months post-discharge.

We conducted multiple regression analysis to assess which variables were associated with the three outcome variables during the immediate healing time (Table 3). Treatment with MMF, greater interfragmentary displacement, less number of extracted teeth, greater maximal interincisal opening, more positive self-assessment of mental health (MHI-5), positive self-reported health status, and lower self-reported pain were significant predictors of higher R1-GOHAI score at 10 days post-discharge. At 1 month, treatment group, self-reported health status and number of extracted teeth were no longer significant predictors, but all other predictors that were significant at 10 days post-discharge remained significant at 1 month post-discharge. Additionally, males had higher GOHAI scores at 1 month post-discharge.

For MHI-5, six significant predictors were found from 10-day follow-up data: age, gender, treatment group, number of fractures, GOHAI and self-rated pain scores. The 40+ age group had lower mental health scores compared with the youngest age group. Males and RIF patients had higher mental health scores. Having fewer fractures, higher GOHAI scores and lower self-rated pain scores were significantly associated with higher self-assessment of mental health at 10 days post-discharge. Using

Table 2. Frequency and mean scores at three time periods

	% Always/often responses (n = 336)			Mean item scores (SD) (n = 336)		
	10 days	1 month	6 months	10 days	1 month	6 months
Functional impacts						
GOHAI mean score (SD)				28.6 (8.80)	31.5 (9.49)	42.6 (10.59)
1. Limit kinds or amounts of food you eat because of problems with your teeth or jaw	83	74	22	1.22 (0.54)	1.38 (0.69)	2.34 (0.82)
2. Have trouble biting or chewing any kinds of food, such as firm meat or apples	87	76	25	1.20 (0.53)	1.38 (0.72)	2.33 (0.85)
3. Able to swallow comfortably	59	60	69	1.65 (0.84)	1.66 (0.86)	1.50 (0.79)
4. Teeth or wires prevented you from speaking the way you wanted to	68	52	16	1.46 (0.72)	1.71 (0.81)	2.50 (0.76)
5. Able to eat anything without feeling discomfort	16	21	44	2.55 (0.76)	2.40 (0.81)	1.90 (0.88)
6. Limit your contacts with people because of the condition of your teeth or jaws	37	33	18	2.06 (0.89)	2.13 (0.88)	2.44 (0.78)
7. Displeased or unhappy with the looks of your teeth and gums, or jaws	60	54	37	1.59 (0.75)	1.70 (0.83)	2.11 (0.91)
8. Use medication to relieve pain or discomfort around mouth	61	46	17	1.61 (0.82)	1.91 (0.91)	2.51 (0.77)
9. Worried or concerned about the problems with your teeth, gums or jaws	69	68	51	1.44 (0.72)	1.47 (0.73)	1.85 (0.91)
10. Feel nervous or self-conscious because of problems with your teeth, gums or jaws	40	35	27	1.96 (0.87)	2.03 (0.85)	2.24 (0.85)
11. Feel uncomfortable eating in front of people because of problems with teeth	43	42	23	1.94 (0.90)	1.94 (0.87)	2.38 (0.83)
12. Teeth or gums sensitive to hot, cold or sweets	49	42	33	1.82 (0.87)	1.94 (0.88)	2.15 (0.89)
	% 'Extremely/quite a bit' responses (n = 336)			Mean item scores (SD) (n = 336)		
Psychosocial impacts						
Mental Health Inventory Items (MHI-5) mean score (SD)				17.7 (4.10)	18.0 (4.03)	18.6 (4.02)
13. Felt calm and peaceful	36	37	45	2.01 (0.85)	2.01 (0.84)	2.17 (0.84)
14. Felt nervous	10	10	12	1.33 (0.64)	1.32 (0.65)	1.37 (0.68)
15. Felt downhearted and sad	17	13	10	1.47 (0.77)	1.42 (0.71)	1.35 (0.66)
16. Been a happy person	29	33	41	1.93 (0.80)	1.97 (0.82)	2.12 (0.82)
17. Felt depressed	14	13	12	1.44 (0.72)	1.39 (0.71)	1.37 (0.69)
	% Excellent/very good response (n = 336)			Mean item scores (SD) (n = 336)		
General health						
Would you say your health is …	31	29	37	2.18 (0.64)	2.16 (0.62)	2.20 (0.69)

1-month follow-up data, age and number of fractures dropped out of the model; instead, smaller displacement and treatment group showed a significant association with higher MHI-5 scores.

Regarding self-reported health status, significant predictors of higher ratings at 10 days post-discharge were fewer patient complaints, higher GOHAI scores and treatment with MMF. Using 1-month follow-up data, number of patient complaints and GOHAI dropped out of the model, leaving treatment with MMF and adding motor deficit as significant predictors.

Finally, we implemented a longitudinal growth-curve analysis of GOHAI scores over four time periods (discharge, 10 days post-discharge, 1 month post-discharge, and 6 months post-discharge). We fit a linear model allowing for random intercepts and slopes in each treatment arm, thus allowing individuals to exhibit distinct trajectories of GOHAI scores over time (Fig. 2). To address the uneven intervals between measurements in a way that would plausibly give rise to a linear model, we allowed the random slopes to be multipliers of $\log(1 + t)$, where t reflected time in months (anchored at $t = 0$ at discharge). The results indicated a significantly higher average intercept for MMF treatment group (29.67) than in the RIF treatment group (25.38). This means that patients

Table 3. Multiple regression models of three self-reported outcome variables (GOHAI, MHI-5, self-reported health status) at 10 days and 1 month post-discharge

	10 days			1 month		
Variables	Beta	SE	*P*-value	Beta	SE	*P*-value
GOHAI						
Constant	11.76	3.35	0.0005	10.69	3.84	0.0057
Age: 29–39 years	0.35	1.00	0.7253	0.47	1.13	0.6761
Age: 40+ years	0.39	1.15	0.7324	1.05	1.33	0.4319
Gender	1.73	1.31	0.1867	3.33	1.47	0.0236
Hispanic	−1.58	1.07	0.1412	−1.30	1.21	0.2840
Other	−2.44	1.78	0.1704	0.52	2.09	0.8028
Treatment group	−2.27	1.15	0.0494	−2.14	1.24	0.0845
Education	−0.71	0.91	0.4310	−1.73	0.98	0.0776
Displacement group	1.47	0.62	0.0345	2.92	0.75	0.0001
No. of teeth extracted	−2.07	0.83	0.0129	0.16	0.95	0.8636
No. of fractures	1.21	0.86	0.1613	−0.61	0.97	0.5315
Maximal interincisal opening	0.14	0.03	0.0006	0.09	0.03	0.0015
No. of patient complaint	−0.72	0.41	0.0753	−0.62	0.51	0.2248
Any sensory deficit	−1.08	1.18	0.3657	−1.35	1.23	0.2760
Any motor deficit	0.43	1.63	0.7912	−0.49	2.05	0.8128
Any burning, tingling or pain	1.19	1.19	0.3165	−0.40	1.50	0.7902
MHI-5	0.65	0.11	0.0000	0.89	0.13	0.0000
Self-rated pain	−0.53	0.15	0.0004	−0.45	0.18	0.0114
Self-reported health status	1.49	0.53	0.0046	0.82	0.67	0.2230
MHI-5						
Constant	12.73	1.59	0.0000	12.27	1.55	0.0000
Age: 29–39 years	−0.60	0.52	0.2465	−0.62	0.55	0.2599
Age: 40+ years	−1.47	0.55	0.0074	−0.98	0.56	0.0820
Gender	1.87	0.69	0.0069	1.29	0.68	0.0579
Hispanic	−0.48	0.57	0.4019	−0.49	0.54	0.3645
Other	0.42	0.96	0.6629	−1.35	0.93	0.1502
Treatment group	1.95	0.57	0.0007	1.45	0.57	0.0110
Education	0.25	0.48	0.6003	0.61	0.45	0.1738
Displacement group	−0.11	0.43	0.7928	−0.85	0.35	0.0168
No. of teeth extracted	0.72	0.45	0.1087	−0.36	0.42	0.3933
No. of fractures	−0.96	0.44	0.0288	−0.03	0.47	0.9449
Maximal interincisal opening	−0.03	0.02	0.1205	−0.01	0.01	0.3054
No. of patient complaints	0.04	0.22	0.8607	0.13	0.22	0.5681
Any sensory deficit	0.01	0.62	0.9888	0.77	0.55	0.1666
Any motor deficit	−1.18	0.76	0.1197	0.03	0.93	0.9716
Any burning, tingling or pain	0.30	0.69	0.6594	−0.11	0.61	0.8540
GOHAI	0.18	0.03	0.0000	0.17	0.02	0.0000
Pain	−0.19	0.08	0.0146	−0.23	0.08	0.0078
Self-reported health status	0.13	0.30	0.6715	0.15	0.34	0.6622
Self-reported health status						
Constant	2.83	0.34	0.0000	3.08	0.32	0.0000
Age: 29–39 years	−0.13	0.11	0.2011	−0.18	0.10	0.0741
Age: 40+ years	−0.22	0.12	0.0675	−0.09	0.12	0.4359
Gender	0.07	0.15	0.6606	0.14	0.14	0.3131
Hispanic	0.04	0.13	0.7359	−0.16	0.11	0.1541
Other	−0.06	0.21	0.7648	0.16	0.21	0.4393
Treatment group	−0.27	0.14	0.0564	−0.42	0.11	0.0002
Education	0.07	0.12	0.5594	−0.02	0.09	0.8724
Displacement group	0.08	0.08	0.3611	0.06	0.08	0.4399
No. of teeth extracted	0.11	0.09	0.2137	−0.04	0.09	0.7034
No. of fractures	−0.06	0.09	0.5293	−0.01	0.09	0.9804
Maximal interincisal opening	−0.01	0.01	0.8625	0.03	0.01	0.3566
No. of patient complaints	−0.14	0.04	0.0010	−0.04	0.05	0.4668
Any sensory deficit	0.04	0.13	0.7940	−0.13	0.11	0.2326
Any motor deficit	0.12	0.16	0.4424	0.45	0.20	0.0224
Any burning, tingling or pain	−0.22	0.14	0.1147	0.17	0.13	0.1944

Table 3. Continued

	10 days			1 month		
Variables	Beta	SE	*P*-value	Beta	SE	*P*-value
GOHAI	0.02	0.06	0.0045	0.01	0.01	0.2044
Self-rated pain	0.02	0.16	0.3330	−0.03	0.02	0.1793
MHI-5	0.01	0.13	0.6762	0.01	0.01	0.7516

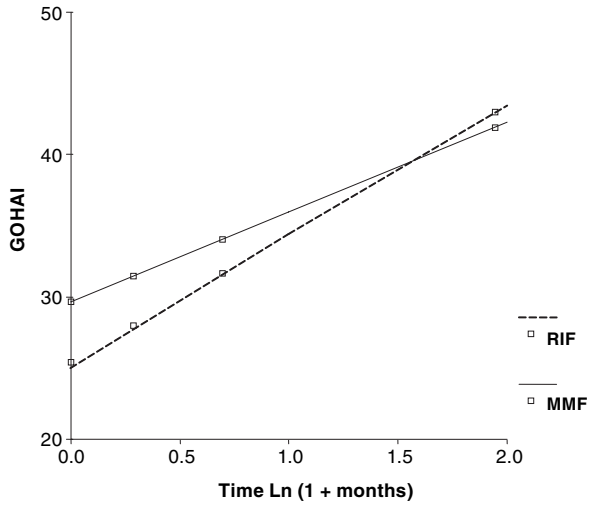


Fig. 2. Comparison of longitudinal growth curve analysis of GOHAI scores by treatment group.

with MMF self-report fewer problems in the early days after placement of intra-arch wires, compared with patients with RIF. Meanwhile, the increase in GOHAI scores over time was significantly greater in the RIF group than in the MMF group. The implication is that while differing at discharge, the GOHAI scores in the respective treatment arms are comparable at 6 months post-discharge.

Discussion

This study confirms the importance of evaluating multiple outcome measures characterizing oral health, mental health and general health to understand surgical outcomes of orofacial injury. There is a substantial literature suggesting that a traumatic incident, such as interpersonal violence or a motor vehicle injury, resulting in a fracture can impact the individual in various ways.

The regression analysis confirms the essence of our conceptual model, with the GOHAI measure of quality of life showing positive associations with objective clinical measures of healing (one's ability to open one's mouth), mental health, subjective patient reports (patient complaints and pain) and patient characteristics (gender). The variables associated with patient injury (number of fractures, interfragmentary displacement and number of teeth extracted) did not show residual associations with the GOHAI score at 10 days or 1 month post-discharge.

The lack of residual association between the objective and subjective healing characteristics after controlling for the GOHAI measure helps to confirm the validity of the GOHAI as an oral health-related quality of life outcome measure. In a multiple regression model, the only health-related variables associated with the mental health assessment were the GOHAI score and the degree of pain reported by the patient. The finding that, at 10 days post-discharge, patients reported themselves to be mentally sound, with many reports of being calm and peaceful, suggests two possible explanations. It is possible that use of prescribed analgesics, by almost all fracture patients early in the healing process, may interfere with accurate reporting of mental health problems. Alternatively, in the wake of a traumatic experience, people may be reporting the exuberance of having no more severe injury than a facial fracture. Two patient characteristics, sex and age group, were also related to the mental health score. It is surprising that females reported more oral and mental health impacts associated with orofacial injury. Future analyses must consider the etiology of the injury and the level of support afforded to these victims to gain a better understanding of this finding. Some of the female patients reported domestic violence as the cause of the injury. Being injured by someone close to an individual may be more psychologically hurtful for females than the often-casual interpersonal violence men reported. Self-reported health status was only associated with treatment group, number of patient complaints and GOHAI score at 10 days, and treatment group and motor deficit at 1 month but the overall model *F*-test was not significant at 1 month.

The findings support the requirements of objectivity, reliability, and validity of adequate outcome measures. Any outcome measure must be valid to

accurately describe appropriate functional problems and to monitor improvements or decrements over time. This allows the clinician to assess the course of recovery and the effects of treatment. The GOHAI and the MHI-5 were independent and, as confirmed by the regression analysis, represented different aspects of the patient's characteristics during the recovery process. In addition, the mean GOHAI scores demonstrated improvement over time. To be clinically useful, an outcome measure must also be easy to administer, and require little time or equipment. The two short patient-reported measures meet that requirement. In addition, the 12-item measure of changes in reported impacts offer important symptomotology information on patient-reported problems. Finally, an outcome measure must be sensitive to detect changes that are clinically important. The size of a clinically relevant change may vary by the disease under consideration as well as the specific aspect of change being measured. Future studies with different types of injury will help clinicians to better understand the problems patients undergo during healing and devise interventions to reduce the impact over time.

One limitation of this study is that health behavior that can affect one's propensity to become injured or, later, to affect healing, is not considered in this study. The literature acknowledges that behavior, such as alcohol use, is associated with the cause of an injury. Continued use of drugs and alcohol, or lack of oral hygiene, may retard the healing of an injury and lead to poorer oral health-related quality of life. The lack of information on continued use of alcohol and drugs during healing prevented the inclusion of health behaviors in the current model and must be evaluated in future research.

Finally, while the results of this study shed more light on the association between subjective and objective measures of healing and perceived health and quality of life, future studies should examine the interconnectedness of a global health assessment of self-reported health and more specific assessments of emotional health and oral health as measures of quality of life following oral surgery.

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