Original Article

Perception of Occlusion, Psychological Impact of Dental Esthetics, History of Orthodontic Treatment and Their Relation to Oral Health in Naval Recruits

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ABSTRACT

Objective: To investigate whether the oral health of young male adults was related to (1) the degree of self-perceived malocclusion, (2) the degree of experienced negative psychosocial impact of dental esthetics, and (3) the history of orthodontic treatment and its duration.

Materials and Methods: The study subjects were 470 male naval recruits undergoing a routine dental health checkup. They answered the Perception of Occlusion Scale (POS) and Negative Impact of Dental Aesthetics Scale (NIDAS). The Approximal Plaque Index (API), the Sulcus Bleeding Index (SBI), and the number of decayed teeth (DT) and missing teeth (MT) were examined by a staff dentist. Statistical procedures were one-way analyses of variance in the API and SBI and nonparametric Kruskal-Wallis, Mann-Whitney, and χ^2 tests in DT and MT as dependent variables.

Results: (1) The subjects ranging within the upper POS quartile scored higher on the SBI (contrast: $P = .003$) and DT ($P = .002$) than did those in the lower POS quartiles. (2) In contrast to the subjects reporting minor negative impacts in the NIDAS, those with strong impacts had higher scores on the API and MT (each $P < .001$). (3) In the subjects with a history of orthodontic treatment lasting 30 months and longer, lower API ($P < .05$), SBI and DT (each $P = .002$), and MT ($P = .007$) scores were found than in the subjects without previous orthodontic treatment.

Conclusion: The results suggest that self-perceived dental irregularity and negative impact of dental esthetics might affect oral health, whereas previous extensive orthodontic treatment may have favorable effects by improving dental health compliance.

KEY WORDS: Oral health; Perception of occlusion; Dental esthetics; Dental compliance; Orthodontic treatment; Psychosocial impact

INTRODUCTION

Orthodontic patients mainly seek treatment for improvement of dental esthetics and oral health.[1,2] While there is agreement that the former is normally achieved in cooperative patients,[3,4] there is contradict-

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ing evidence with regard to the latter. Tooth malalignment is associated with plaque accumulation, gingival inflammation, or caries only in severe cases and in patients with insufficient oral hygiene.[5,6] However, there might be another, indirect contribution of dental occlusion to oral health. Research on general body concept has found that individuals perceiving their dental appearance as less attractive may feel discouraged in performing health behaviors to improve or preserve their physical condition.[7] They tend to avoid not only the presentation of their body in public[8] but also self-confrontation with the mirror image.[9] As a consequence, such individuals tend to exercise less[10] and show more maladaptive nutritional habits[11] than attractive individuals do. It has been suggested that such a relationship between attractiveness and health behavior might also apply to dentistry. A study on highly educated young adults found that individuals with a less esthetic dental appearance had less favorable at-

titudes toward dental health.[12] In addition, they reported less oral hygiene practice and a higher incidence of gingival inflammation and caries than did subjects with excellent dental esthetics. On the basis of this observation, it is of interest whether the results derived from self-reports would be replicated using clinical oral health measures such as scoring of plaque accumulation, gingival bleeding, caries, and missing teeth. In countries with military conscription, routine health checkups of military recruits present a convenient opportunity to obtain a sample of subjects representing the general population of the corresponding age group. In the present study, dental records of navy recruits were related to their questionnaire responses. The first aim of this study was to investigate whether navy recruits varying in the degree of self-perceived dental malocclusion differ in oral health.

Results of psychosocial attractiveness research suggest that the perception of one's own physical appearance is often associated with concerns about other people's reactions and a negative body concept,[7] which additionally discourage efforts to maintain or enhance the physical condition by health behaviors. It has been shown, for instance, that minor dental esthetic impairment in young adults was associated with social apprehension, appearance disapproval, and appearance-related insecurity.[13,14]

On the basis of these findings, we decided to investigate whether these dental esthetics–related impairments of psychosocial well-being might have clinically measurable effects on oral health. The second aim of this study was to investigate whether individuals with varying degrees of perceived negative impacts of dental appearance differ in their oral health.

A potential beneficial effect of orthodontics may result from oral hygiene training, as repetitive oral hygiene instructions and performance assessment are an integral part of orthodontic treatment.[15,16] Davies et al[17] found a greater reduction in plaque and gingivitis scores in orthodontic patients than in nonpatients, which, however, instead of being related to tooth alignment, were explained by behavioral factors reflecting regular attendance and oral hygiene monitoring. According to Southard et al,[18] naval recruits with a history of orthodontic therapy had fewer carious lesions and missing teeth than did those without. Furthermore, a history of orthodontic treatment was associated with positive dental attitudes, improved oral hygiene practice, and subjective oral health in young adults.[12]

According to several studies, oral hygiene is readily attained in the short-term perspective, but without reinforcement, it tends to relapse.[19,20] Orthodontic treatment is a convenient opportunity for long-term monitoring of oral hygiene behavior, and it is possible that treatments of long duration might help establish a sta-

ble oral health behavior pattern. The average orthodontic treatment duration of about 30 months has been reported in various studies[5] and was used subjectively as a cutoff point discriminating between former patients with long or short orthodontic treatment. The third aim of the present study was to investigate whether recruits with a history of long orthodontic therapy differ in their oral health from those with shorter or no treatment.

MATERIALS AND METHODS

Naval recruits at the start of service were included in this investigation. The study protocol was approved by the Ministry of Defense, and written consent was obtained from each study subject. From an initial 503 male recruits, 25 declined to participate and 8 returned incomplete questionnaires, leaving a total of 470 participants. The mean age of the subjects was 19.8 years (SD = 1.2). During the questionnaire procedure, the subjects followed the instruction not to exchange their views with other participants. Two dentists with a professional experience of 12 and 15 years conducted the clinical examination.

Instruments

Perception of Occlusion Scale[21]. The participants were requested to evaluate the arrangement of their teeth using six items referring to upper and lower crowding and irregularity, spacing between upper incisors, and open bite. A 4-point answering format was presented with 1 = *not at all,* 2 = *a little,* 3 = *moderate,* and 4 = *strong.* A high retest reliability of $r_{tt} = .90$ was found over a 4-week interval.

Negative Impacts of Dental Appearance Scale. This measure represents a short form of the Psychosocial Impact of Dental Appearance Questionnaire[14] and includes 12 items referring to the perceived negative social and psychological impacts of their dentition. The internal consistency of this form is $\alpha = .88$. Example items are "I don't like to see my teeth in the mirror," I am somewhat distressed when I see other people's teeth," or "I am afraid other people could make offensive remarks about my teeth."

Approximal Plaque Index[22]. The indices were assessed by probing the interdental spaces on the buccal aspect of the upper left and lower right quadrants and the lingual aspect of the upper right and lower left quadrant. Plaque on the probe was recorded as a positive finding. The number of findings divided by the number of examined sites resulted in a percentage index.

Sulcus Bleeding Index[23]. A periodontal probe was gently guided through the sulcus of the same examination sites as in the Approximal Plaque Index (API).

Table 1. Results of Comparisons Between Respondents of the Quartiles of the Perception of Occlusion (POS)[a]

	Statistic	Perceived Malocclusion				Comparisons (P)	
		1 = Low (n = 138)	2 (n = 107)	3 (n = 131)	4 = High (n = 94)	Among All Groups	High vs Preceding
Approximal plaque	M (SD)	41.05 (25.23)	40.70 (23.71)	39.92 (25.58)	47.39 (26.98)	$F = 1.86$ (.134)	$t = 2.33$ (.019)
Sulcus bleeding	M (SD)	16.81 (22.19)	17.66 (19.09)	17.14 (20.60)	24.84 (27.49)	$F = 3.00$ (.030)	$t = 2.96$ (.003)
Decayed teeth	M (MR)	1.25 (221)	1.48 (232)	1.32 (226)	2.30 (271)	$\chi^2 = 9.85$ (.020)	$Z = 3.06$ (.002)
Subjects with ≥1 missing tooth	%	10.1	13.1	13.7	16.0	$\chi^2 = 1.78$ (.61)	$\chi^2 = 0.92$ (.337)

[a] Scale (POS) for respondents' oral health: means (M) and standard deviations (SD) in the Approximal Plaque Index and Sulcus Bleeding Index, mean (M) and mean rank (MR) in decayed teeth, percentages of subjects with ≥1 missing tooth, statistical tests of overall effects (F or χ^2 coefficients), and difference contrasts between upper and preceding lower quartiles (t, Z, or χ^2 coefficients) and P values.

The number of bleeding points was divided by the number of the probing sites, resulting in a percentage bleeding index.

Decayed and missing teeth. The number of teeth showing carious lesions in need of treatment was recorded. Missing teeth were counted, not including first premolars extracted for orthodontic reasons.

Statistical Analyses

In all analyses, the Statistical Program for Social Sciences was applied. According to the first two aims of the study, exposure thresholds[24] of the Perception of Occlusion Scale (POS) and the Negative Impacts of Dental Appearance Scale (NIDAS) were defined by their quartile points. Cutoff points were determined by the test values meeting or transgressing the respective quartile. One-way analyses of variance were conducted to test the API and Sulcus Bleeding Index (SBI) differences between subjects included in the quartiles. To assess mean value increments, difference contrasts were calculated comparing subjects of the second to the fourth quartile each with the preceding ones. The Kruskal-Wallis test was used with decayed teeth (DT) as a dependent variable on the general level. Mann-Whitney tests were applied to compare the second to fourth quartile with the preceding ones. Percentages of subjects with at least one missing tooth (MT) were examined for differences across quartiles by χ^2 tests on the general and specific level.

With regard to the third aim of the study, one-way analyses of variance were applied, including simple contrasts to compare subjects with histories of a long treatment duration to those with short and no treatment, with API and SBI as dependent variables. To analyze the DT and MT scores, nonparametric tests were used as described above.

RESULTS

Table 1 presents the results regarding the question of whether respondents with varying degrees of per-

ceived malocclusion differ in their oral health. On the general level, the F values indicate significant differences between the groups for the SBI and DT, both with $P < .05$. The inspection of API, SBI, and DT mean values revealed that they were not different between the first three quartiles but that there were marked increases in the highest quartile. Statistically, the difference between subjects scoring high on the POS and the remaining subjects was significant at a low level of $P < .05$ in the API and at a moderate level ($P < .01$) in the SBI and DT. All other contrasts were not significant, with $P > .05$.

The results of testing the assumption that subjects with varying degrees of negative impacts of dental esthetics differ in their oral health are shown in Table 2. Generally, the F values indicate significant differences between NIDAS quartiles on all dependent variables, with error probabilities ranging from $P < .05$ (SBI) to $P < .001$ (DT). When the API, SBI, and DT mean values were compared, remarkable increments were found only in the fourth NIDAS quartile. In subjects of this group, more plaque, gingival bleeding, and DT were found than in the remaining ones. This effect was moderately significant for the SBI at $P < .01$ and strongly significant for the API and DT, both at the level of $P < .001$. Twenty-three percent of the respondents in the upper NIDAS quartile had at least 1 MT, while in the remaining quartiles, this proportion was about 10%. This difference was also highly significant with $P < .001$. In addition, the contrast comparison of the second and first NIDAS quartile in DT was significant at $P < .05$ (Mann-Whitney $Z = 2.54$). All other comparisons proved not significant.

According to the third study aim, more subjects in the short-term therapy group had been treated with a fixed appliance (22%) and fewer subjects had undergone a two-stage therapy (22%) as compared to the long-term group (12% and 39%, respectively). The remaining subjects had been treated with removable ap-

Table 2. Results of Comparisons Between Respondents of the Quartiles of the Negative Impact of Dental Aesthetics Scales in Their Oral Health[a]

	Statistic	Negative Impact of Dental Aesthetics				Comparisons (P)	
		1 = Low (n = 106)	2 (n = 134)	3 (n = 113)	4 = High (n = 117)	Among All Groups	High vs Preceding
Approximal plaque	M (SD)	40.24 (23.72)	39.22 (24.28)	38.85 (24.11)	49.53 (28.08)	$F = 4.78$ (.003)	$t = 3.76$ (.000)
Sulcus bleeding	M (SD)	16.27 (20.52)	16.57 (23.02)	18.41 (19.64)	23.63 (26.47)	$F = 2.74$ (.043)	$t = 2.74$ (.006)
Decayed teeth	M (MR)	0.77 (192)	1.12 (220)	1.65 (244)	2.57 (282)	$\chi^2 = 27.52$ (.000)	$Z = 21.26$ (.000)
Subjects with ≥1 missing tooth	%	8.5	10.4	9.7	23.1	$\chi^2 = 14.26$ (.003)	$\chi^2 = 14.06$ (.000)

[a] Means (M) and standard deviations (SD) in the Approximal Plaque Index and Sulcus Bleeding Index, mean (M) and mean rank (MR) in decayed teeth, percentages of subjects with ≥1 missing tooth, statistical tests of overall effects (F or χ^2 coefficients), and difference contrasts between upper and preceding lower quartiles (t, Z, or χ^2 coefficients) and P values.

Table 3. Results of Comparisons Between Respondents With Different Orthodontic Treatment History in Their Oral Health[a]

	Statistic	Orthodontic Treatment			Comparisons (P)		
		Never Received (n = 241)	Short Term (n = 83)	Long Term (n = 132)	Among All Groups	Long Term vs Never	Long Term vs Short Term
Approximal plaque	M (SD)	43.09 (26.68)	43.73 (26.00)	37.32 (25.17)	$F = 2.74$ (.066)	$t = 2.16$ (.031)	$t = 1.85$ (.064)
Sulcus bleeding	M (SD)	20.22 (22.76)	23.01 (26.75)	13.03 (16.78)	$F = 6.53$ (.002)	$t = 3.01$ (.002)	$t = 3.23$ (.001)
Decayed teeth	M (MR)	1.61 (238)	1.91 (249)	1.11 (197)	$\chi^2 = 12.44$ (.002)	$Z = 3.14$ (.002)	$Z = 2.98$ (.003)
Subjects with ≥1 missing tooth	%	17.8	7.2	7.6	$\chi^2 = 10.92$ (.004)	$\chi^2 = 7.37$ (.007)	$\chi^2 = 0.01$ (.925)

[a] Means (M) and standard deviations (SD) in the Approximal Plaque Index and Sulcus Bleeding Index, mean (M) and mean rank (MR) in decayed teeth, percentages of subjects with ≥1 missing tooth, statistical tests of overall effects (F or χ^2 coefficients), and simple contrasts comparing long-term treatment versus on treatment and long- versus short-term treatment (t, Z, or χ^2 coefficients) and P values.

pliances (56% and 49% in the short- and long-term groups, respectively). The difference in treatment procedures was significant at a low level ($\chi^2 = 8.44$; $P < .05$). Table 3 presents results of testing the question as to whether subjects with a history of a longer orthodontic treatment (≥30 months) differ in their oral health from those with shorter treatment (≥12 and <30 months). F values indicate significant differences between groups in the SBI, DT, and MT at a general level (all $P < .01$). Compared to the no-treatment group, subjects with at least 2½ years of orthodontic treatment showed less interdental plaque ($P < .05$) and sulcus bleeding as well as fewer DT and MT (all three at $P < .01$). In addition, there was a difference in the SBI and DT (both $P < .01$) between the subjects with a long and short treatment history.

DISCUSSION

The general purpose of the present study was to test the putative relationship of oral health to self-perceived occlusion, negative impacts of dental esthetics,

and history of orthodontic treatment in young adults as represented by naval recruits.

The first assumption tested in the present study was that individuals varying in the degree of self-perceived malocclusion would differ in their oral health. This was confirmed by the results of the dental examination, which revealed that subjects ranging within the upper quartile of the POS had more gingival bleeding sites and DT. This assumption was derived from the social psychology knowledge of interrelations between general physical attractiveness and health behavior.[7–11] It may be concluded that these associations also apply to the specific domain of dentistry.

Gingival inflammation reflects mainly long neglect of dental hygiene.[25,26] Untreated DT are found in persons who report a long time span since their last dental visit.[26] It may be suggested that persons with self-perceived malocclusion are prone to insufficient oral hygiene and dental appointment compliance. A previous study found that young adults with less favorable dental esthetics reported less frequently with less regular

dental cleaning behavior and appointment regularity.[12] In addition, they reported more frequent gingival bleeding and necessary caries treatment. Those findings, which were derived from self-reports, are substantiated and extended by the present data, which are based on clinical examination.

As a second aim of this study, the relationship of the NIDAS to the results of the oral health examination was tested. Subjects in the fourth NIDAS quartile were found to differ from the remaining ones in all four oral health measures, with the SBI on a medium level of significance and the API, DT, and MT on a high level. Participants ranging within the upper NIDAS quartile had 10% higher plaque scores than those in the lower quartiles. This is of clinical significance as these API grades reflect poor as opposed to just satisfactory oral hygiene.[22] Respondents with high negative impacts of their dental arrangement also showed a gingival bleeding rate that indicates treatment needs,[23] while the SBI in all remaining quartiles was within the range of a mild inflammation. Moreover, the high negative impact group had nearly two more DT (2.5 DT) than did those with the lowest impacts (0.8 DT). Finally, among the respondents who experience highly negative impacts of dental appearance, the proportion of those with at least one MT was 13% higher than in subjects with minor impacts.

The effect of negative impacts of dental appearance on oral health was stronger than the effect of self-perceived occlusion. This suggests that the subjective meaning of dental appearance relating to social experience and affective reactions might additionally contribute to oral health behavior. Individuals associating negative affects with their teeth may avoid all reminders of their dental appearance, including oral hygiene and dental appointments. Ebbeck et al[11] suggested that both appearance-related affect and self-perceived attractiveness contribute to motivation or discouragement of general health behavior. This assumption was substantiated by the present data and thus may be extended to the field of dentistry.

A final topic of this study was to investigate whether subjects with a history of long orthodontic treatment lasting 30 months or more differ in their oral health from those without treatment experience. A history of treatment was found to be associated with a more favorable oral health condition with respect to the API at a lower level of significance and SBI, DT, and MT at a higher level of significance. Dental plaque accumulation reflects actual cleaning practice, which may be improved in some subjects expecting a dental examination. Sulcus bleeding might be a better indicator of long-term oral hygiene performance.[25] It is conceivable that the subjects with 2½-year-long oral hygiene monitoring and training during their orthodontic treatment

in the past might have maintained their learned skills to the time of the clinical examination in the present study. These results confirm a previous report of more frequent and regular oral hygiene behavior in former orthodontic patients.[12]

The subjects with a history of longer orthodontic treatment had fewer DT and MT than did those without orthodontic experience. These results replicate the findings reported by Southard et al[18] for young people. Untreated carious teeth and tooth extractions may be indicative of irregular dental visits or dental avoidance.[26] It may be assumed that orthodontic patients establish a habit of visiting dentists, thus developing appointment compliance. The measures of oral health in subjects with a history of long orthodontic treatment were superior to those of the subjects with shorter previous treatment. This difference might be explained by a different exposure time to oral hygiene instructions and monitoring.

Several limitations of this study have to be considered. First, the degree of malocclusion was based on subjective perception. Research on general body image found little agreement between physical attractiveness ratings of targets and judges.[7] Although the relation between professional and consumer ratings of orthodontic treatment is much stronger,[7,21] it would be of interest for further research to include a dentist evaluation of dental aesthetics.

Second, it might be argued that the NIDAS reflects impairments based not only on tooth position but also on discolored, yellow, or chipped teeth or a gummy smile. Further studies are needed to investigate whether additional aspects of dental aesthetics account for variations in NIDAS scores.

Third, the present investigation did not include measures of personal concerns, which might be related to psychosocial impacts of dental aesthetics on everyday life. It would be of interest for further research whether personality dispositions (ie, public self-consciousness[7,13] or depression) might explain associations between oral health and self-perception of dental aesthetics and dental appearance–related impairment.

Fourth, only male respondents were included in the study, and therefore, the results can be generalized only for young male adults. Women are more attentive to their physical appearance[27] and may show stronger associations between dental esthetic condition, appearance-related impairment, and oral health. To test this assumption would be a topic for further research.

CONCLUSION

- Young male adults who perceive their dental arrangement as irregular may tend to neglect oral hy-

giene practice as indicated by an inferior oral health condition.
- This tendency may be even stronger in individuals who experience negative social and psychological impacts of their dental appearance.
- Young male adults with previous exposure to orthodontic treatment of a sufficient duration might have established a stable pattern of dental compliance, as indicated by their oral health status.
- Orthodontic patients may benefit in their dental compliance and oral health indirectly by psychological factors because of improved appearance and directly from longer oral hygiene instructions and monitoring during orthodontic treatment.

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