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GENERAL GYNECOLOGY

Adherence to gynecological screening impacted by experienced orthodontic treatment in childhood

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Abstract

Background Dental and cervical controls are two established screening programs in Germany. Compliance to orthodontic treatment in childhood is essential for dental health and one of the first health interventions that requires adherent behavior; therefore, it may be associated with participation in further screening programs in adulthood. However, it is not yet known whether early orthodontic treatment influences long-term screening adherence.

Methods Using a questionnaire administered during a visit to a special dysplasia outpatient service, this case–control study evaluated women's personal history of orthodontic care, long-term satisfaction, and dental and gynecological screening adherence. Oral health status and dental anxiety were assessed with validated instruments. Cases were categorized as cervical dysplasia only (S2) or cervical dysplasia with conization (S1) and compared to healthy controls with a normal PAP smear.

Results A study population of 233 participants included 132 cases and 101 controls. The control group had had orthodontic treatment during childhood more often than our study population with abnormal PAP smears (68.3% controls versus 56.1% subjects; $p < 0.005$). Orthodontic treatment was not associated with attending dental appointment or gynecological check-ups. However, women with an orthodontic treatment in childhood were significantly more often vaccinated against human papillomavirus than women without orthodontic treatment ($p < 0.03$).

Conclusion Data suggest that women with orthodontic treatment in childhood are more conscious about prevention strategies in adulthood; therefore, compliant behavior might be established in childhood.

Keywords Compliance · Adherence · Screening · Orthodontic treatment

Introduction

German health insurance companies recommend dental visits between the age of 2.5 and 18 at least twice a year, and at least once a year after the age of eighteen depending on the patient's personal caries risk. Oral health is understood to be an essential component of general health; in addition to improving outcomes of cardiovascular disease, diabetes, and other serious health conditions, good oral health also improves pregnancy outcomes. Therefore, the American College of Obstetricians and Gynecologists recommends maintaining good oral health habits throughout the lifespan, an advice which is not consequently followed by all women, with 35% women missing a dental visit within the last year [1]. As well, among patients with a chronic disease, dental visits are known to be unsatisfying [2]. A study by Isong has shown that children's behavior regarding oral health is influenced by their parents [3]. Frequent dental visits are especially necessary for orthodontic treatment in childhood or adolescence. Orthodontic treatment with an indication for removable or fixed appliances or a combination of both usually requires monthly to 3-monthly visits at the practitioners' offices, usually over 4 years. For therapy success in orthodontics, patient compliance is crucial [4].

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For adult patients, cancer screening programs for breast, cervical, skin, prostate and colon cancer are well established within Germany also requiring patient compliance. Cytological cervical cancer screening is accessible on a yearly basis for all women starting at the age of 20 [5, 6]. A suspicious cytology smear can result either in close meshed monitoring or in surgical treatment for high grade intraepithelial neoplasia or carcinoma in situ to reduce the incidence and mortality of cervical cancer [7]. The establishment of nationwide screening programs has significantly decreased the incidence of cervical cancer in Germany and other industrial nations [8, 9]. These programs are major health care interventions and should reach as many women as possible to effectively reduce mortality. In Germany, the participation in the cervical cancer screening program is voluntary [8, 10]. Barriers to adherence to screening modalities, such as a low socioeconomic or educational status have been described in literature [11, 12]. Additionally, an abnormal cervical smear can increase anxiety and can compromise compliance [10, 13, 14]. To improve adherence and consequently reduce cancer incidence, several different approaches have been already evaluated in the past [8].

Socioeconomic status is a known determinate for participation in gynecological screening, and gender is a known crucial factor in dental compliant behavior [15, 16]. We hypothesize that orthodontic treatment experience at a young age can shape, affect, and educate a general better compliant behavior towards preventive screening programs in adulthood. In this study, childhood and adolescence experiences with orthodontic treatment are evaluated using a case–control design to examine the screening behavior of women with cervical dysplasia. The aim is to identify factors and strategies that can positively impact long-term adherence behavior and improve patient care and outcomes.

Methods

Study population

All counselees who attended the special dysplasia outpatient clinic at the University Hospitals in Heidelberg and Leipzig between November 2015 and May 2017 were eligible to participate if they provided written informed consent. Women who were not proficient in the German language or who suffered from a psychiatric disease were excluded. The control group was randomly recruited via social networks. All women who provided written informed consent and answered the questionnaire were defined as the study population. The study protocol was approved by the local ethical committees of the University of Heidelberg (S-399/2015) and of the University of Leipzig (091/17-lk) prior to study start.

Questionnaire

The questionnaire consisted of 50 items. Only dental-related issues are analyzed in this paper (the other results are shown in Heinzler et al. [17]). Standardized, validated instruments were used when available. The first section included sociodemographic information and personal history in respect to orthodontic treatments during childhood and adolescence; if a history of orthodontic treatment was present, the woman's long-term satisfaction with the treatment was asked for. Further questions examined general compliance with dental and gynecological screening modalities. The last section addressed dental anxiety (Dental Anxiety Scale) as well as oral health (OHIP-G 14) issues. The dental anxiety and oral health questions were analyzed as described in the manuals for these validated instruments [18–20].

Data collection

In addition to the questionnaire, information on the medical history of the cases was extracted from the clinical medical documentation system (SAP ECC 6.0 EhP5 SP 14 IS-H 605 SP 25, Walldorf, Germany) and entered into a study-specific data base using Microsoft Excel.

Statistical analysis

Statistical analyses were conducted using SAS 9.4 (SAS, Cary, NC). Continuous data were reported as means and range and categorical data as absolute and relative frequencies. Spearman's rank correlation coefficient was used to evaluate associations between ordinal variables, and the Wilcoxon *U* test was used to test for differences between groups in the case of continuous data or scores. The Chi-squared test evaluated differences between categorical data. $p < 0.05$ (two-sided) was defined as statistically significant.

Results

Study population

209 women were identified as eligible to participate at the special dysplasia outpatient clinic. The study population was ultimately formed by 132 women as 38 withdrew their written consent (active decliners) and 39 did not return the questionnaire (passive decliners). Of the 132 study subjects, 68 had undergone a conization and formed the study subgroup *S*1, whereas 64 women with a suspicious Pap smear had received conservative treatment and formed *S*2 (*S*: study group = *S*1 + *S*2). The control group (*K*) included 101

healthy women. The sociodemographic characteristics are published in detail by Heinzler et al. [17]. In brief, *S*1 (Chi-square $p < 0.002$) and *S*2 (Chi-square test $p < 0.05$) were significantly older than the control group (*S*1: 35.9; *S*2: 34.1 *K*: 30.9). Women in the target group (*S*) were more often in a relationship and had had significantly more pregnancies than the control group (Chi-square test $p < 0.0001$ for *S*1 and *K*; Chi-square test $p < 0.005$ for *S*2 and *K*). There were no differences in education, origin, and medication. The Body Mass Index only differed significantly between *S*2 and *K* (*S*2: 25.0 versus *K*: 22.8; Chi-square test $p < 0.01$).

Orthodontic treatment history

A total of 74 (61.3%) women with cervical dysplasia from the study population (*S*) had received orthodontic treatment at age 18 years or younger [19 solely with fixed braces (25.7%), 34 solely with removable appliances (45.9%), and 21 with a combination treatment of both fixed and removable appliances (28.4%)] versus 69 subjects in the control group *K* [11 solely with fixed braces (15.9%), 21 solely with removable appliances (30.4%), and 37 with a combination treatment of both fixed and removable appliances (53.6%)] (Table 1). A significant difference was recognized in adolescence experience with orthodontic treatment: 58 (43.9%) in the study group versus 32 (31.7%) in the control group did not have orthodontic treatment at all during childhood or adolescence (Chi-square test $p < 0.005$). In the study group with cervical dysplasia, slightly more women had had orthodontic treatment solely with fixed braces (25.7%) compared to the control group (*K*: 15.9% solely fixed braces). Treatment combining removable and fixed appliances differed significantly among both groups (*S*: 28.4% and *K*: 53.6% of those with orthodontic treatment; Chi-square test $p < 0.004$).

All women who had undergone orthodontic treatment in childhood were mostly satisfied with the long-term result. The study group was slightly less satisfied (average 1.98, range 1–5, with a Likert scale one absolutely satisfied five not satisfied at all) than the control group (average 2.6, range 1–5, Likert scale) ($p \geq 0.5$). Only 8 (3.4%) women in total were absolutely not satisfied.

Table 1 Characteristics of the study participants

n	*S*	*K*
	132	101
Orthodontic treatment	74 (61)	69 (68)
Fixed braces	19 (26)	11 (16)
Removable appliances	34 (46)	21 (30)
Combination treatment	21 (29)	37 (54)

n (%) *K* = control group, *S* = target group

Most women who had been treated with removable or a combination of fixed and removable appliances stated retrospectively that they had somewhat followed the wear-time recommendations for their orthodontic device The control group admitted having done so slightly more often than prescribed, indicating an over-compliance (mean $K = 2.4$, range 1–5), compared to the study group ($S = 1.8$ 2–5) (not statistically significant: $p < 0.14$).

Self-care strategies

The women were questioned about their behavior towards the recommended regular dental check-up visits in adulthood. The control group as well as the study group reported having dental visits quite regularly [*S*: mean 4.2 versus *K*: mean 4.4, range 1–5 without significant differences ($p = 0.19$)]. However, the understanding of what the recommended frequency is for dental check-ups differed surprisingly in both groups compared to the actual recommended visits. Almost half of the study subjects (*S*: 46.2% versus *K*: 47.5%) claimed that a dental check-up twice a year is the standard by law in Germany. General knowledge about the correct annual recommended dental examination was given by 46.9% in the study population *S* and by 46.5% of the control group *K*. The subgroup analysis, independently of the study or control group but with respect to previous orthodontic treatment, also did not reveal any significant differences in terms of dental surveillance care ($p < 0.3$). Respectively, this subgroup analysis showed frequent visits to the dentist regardless of former orthodontic treatment status (average former orthodontic patients = 4.2 versus no orthodontic treatment = 4.1; Likert scale 1: never 5: absolutely as recommended). Regarding dental care knowledge, there was also no significant difference ($p = 0.73$), with both groups correctly indicating that a dental check-up once or twice a year is recommended.

Adherence to gynecological community-based surveillance strategies among former orthodontic patients

An annual gynecological check-up was attended without significant differences between those women who had had and those had not had orthodontic treatment in their childhood/adolescence ($p = 0.88$); the same was found for knowledge about the optional frequency for gynecological examinations ($p = 0.55$).

However, independent of *S* or *K* group, women with a history of orthodontic treatment had received an HPV vaccination significantly more often than those without orthodontic treatment (+orthodontic/+HPV vaccination 28% versus 17% no orthodontic treatment/+HPV vaccination, Chi-square test $p < 0.03$). Among these two groups, 9.8% with versus

21.6% without orthodontic treatment had never heard about the possibility of an HPV vaccination or did not know if they were vaccinated.

Oral health and dental anxiety

No differences in terms of dental anxiety were observed between those who had undergone orthodontic treatment compared to those who had not (data not shown). None of the study participants reached a high anxiety level in the sum scores (study subjects *S*1: 9.4, *S*2: 10.3, *K*: 9.9, not significantly different $p = 0.48$). Anxiety of invasive procedures such as injections in gingiva was high in all groups.

Discussion

This case–control study addresses women´s screening adherence in respect to childhood or adolescence orthodontic treatment experience, hypothesizing that compliant behavior is already influenced in childhood and that such an experience may influence lifelong conscious adherent behavior towards screening modalities.

We found that women with dysplasia compared to an abnormal Pap smear had had childhood orthodontic treatment less frequently. It is known that such cervical findings are associated with lower social status, smoking and infections, for example with Chlamydia or HSV [21, 22], which are analogous to risk factors for poor oral health [23]. Additionally, they are concordant with factors impacting dental as well as orthodontic treatment along with incompliant childhood behavior. Epidemiological analyses have outlined that dental status is impacted by the social status gradient [24]. Orthodontic treatment is known to be less common among children with lower socio-economic status [25]. Other studies on compliance with recommended wear-time in respect to removable appliances found less compliant behavior among those with low social status [15, 16]. Beyond these specific results, it is well known that unhealthy behavior in childhood can lead to an increased risk of obesity, lack of physical exercise, and bad nutrition, all of which are more frequent in poorer children and cause severe long-term health risks [24, 26]. Other studies have outlined that parents' health-seeking behavior has an important effect on their children's health regardless of insurance status [3]. Other studies claim that the most important and long-lasting influence on a child's health may be the parents' education [27]. Therefore, either way, the role of health awareness in early childhood is becoming more apparent for long-lasting compliant, adherent health behavior.

61.3% of our study population had had orthodontic treatment at 18 years of age or younger; this is higher than the results of a recent study by Krey et al. who found that only 33.5% of their German study population had had orthodontic treatment [22]. However, their patients were only 11–14 years old, and 55% of the identified orthodontic patients were female.

We maintain that orthodontic treatment is usually the first opportunity for children or adolescents to show active involvement and prove good compliance in a health-related matter. Good outcomes in orthodontic treatment are directly affected by self-controlled wear time of removable appliances, good oral hygiene, and appointment compliance. Our results are concordant with the argumentation that cervical dysplasia occurs more frequently among lower income and education levels, as women in our study group admitted to a slightly lower adherence to wear-time recommendations than the control group. This argument is supported by the responses in our study to the questions on general screening modalities. Women without orthodontic treatment were significant less aware of prevention strategies such as the HPV vaccination, which is recommended nationwide in Germany starting at the age of 11. However, those with orthodontic treatment in the past were vaccinated significantly more often. This supports the argument that generally good adherent health behavior, such as that indicated by orthodontic treatment paths, improves adherence to other preventive strategies in adolescence or adulthood and has no negative impact on long-term general dental anxiety or dental health.

It must be noted that the study subjects were on average 31–36 years old (range 19–56 years). One could argue that they cannot remember their treatment behavior during childhood as well as younger adults might, but we claim that knowingly not following instructions might be remembered. However, the false memories effect might cause misremembering and a more positive reflection. Additionally, it should also be noted that our control group was younger than the target group and was mainly selected from the medical sector due to convenient controls, which may cause a selection bias.

Population-based screening programs are often limited due to low outreach, causing an inefficient use of established resources, as it is known from the breast cancer screening programs [28]. Personal experiences in a young age as well as knowledge about advantages and disadvantageous of screening modalities may impact lifelong preventive behavior, and the outreach might be improved if knowledge is spread already during childhood and adolescence.

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Compliance with ethical standards

Conflict of interest There is no conflict of interest by any author.

Ethical standards This study was approved by the local ethical committee (S-399/2015) and the ethical committee in Leipzig (091/17-lk) and performed in accordance with the Declaration of Helsinki.

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