Orthodontic Appliance Effect on Nutrition

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ABSTRACT:
Orthodontic appliances have been used for many years to treat malocclusions and poor jaw relationships, but their effects on the nutritive intake of the patient have not been extensively documented. This paper aims to consolidate the findings of three studies on the effects of appliances on nutrition by Riordan DJ, Shirazi et al., and Al Jawad et al. Based on a review of these studies, nutrition intake is altered as well as ability to consume the nutrients. Studies showed that copper, manganese, and lipid levels were decreased notably while total fat, cholesterol, saturated fat, monosaturated fat, polysaturated fat, linoleic fat, linolenic fat levels increased. The message conveyed through all three studies is that appliances will acutely alter the patient's diet. This review of the current literature highlights several of the key nutritional changes once orthodontic appliances have been applied to patients.

METHODS:
To identify relevant studies on the nutritional effects orthodontic appliances may have on patients, an electronic search of the US National Library of Medicine through PubMed.gov was conducted within the years 1995-2015. The search strategy focused on using keywords such as 'orthodontics,' 'nutrition,' 'dietary intake,' 'fixed appliance,' eating habits,' 'oral impacts,' 'changes in function,' 'oral health,' 'alterations,' 'diet effects.' Combinations of these keywords were also used. The searches yielded 62 results. The bibliographies of relevant search results were also scanned to find related papers. From these searches an initial 15 papers were obtained that provided insight on the nutritional effects orthodontic appliances may have on patients, and further screening to only include papers with original results from experiment designs gave rise to 3 papers (Figure 1).

Studies compiled for final inclusion included primary literature papers that provide original information acquired through qualitative research on human subjects. Papers were screened for those including nutritional factors such as fat, calories, essential metals, as well as overall dietary intake/eating behavior being compared between orthodontic patients and control groups.

DATA EXTRACTION:
Studies suitable for analysis had data on nutrient substances that provide nourishment essential for growth and maintenance of life or behavioral effects on dietary intake involving these nutrients.

REASONS FOR DATA EXCLUSION:
If the article was not focused on orthodontic appliance's effects on nutrition specifically, but as a piece of overall well-being/health it was removed from the study, this included articles: 3, 7, 8, 9, 10, 11, 12, 13, and 14. If the article did not provide any original information/data or acted mainly as a review it was removed from the study, this included articles: 5, 6, and 14. Finally if article data did not pertain to human trials it was also removed, article 15. See Figure 1.

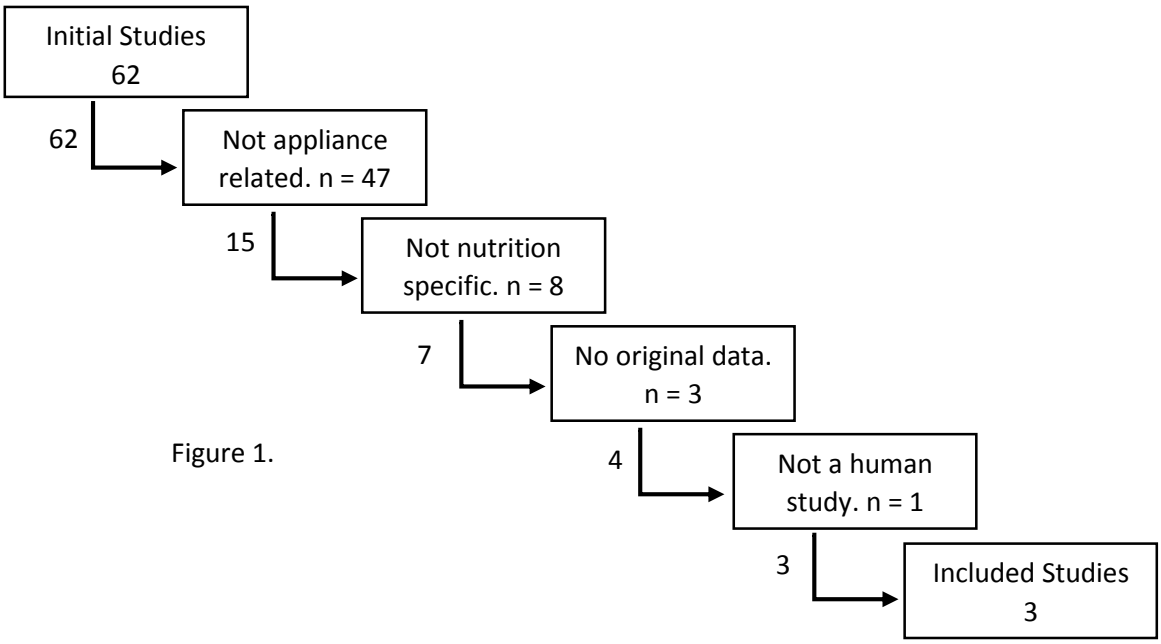

Figure 1.

RESULTS:

After careful review only three papers provided meaningful information on dietary differences related to orthodontic treatment. Table 1 lays out pertinent values from these three studies. Among the studies, the number of participants ranged from 10 to 180, were either Cohort or Cross-Sectional studies, 5 to 8 pages in length, took place in the US, England or Iran, and included male and female participants. Two of these studies provided quantitative information on differences in nutrient intake and one of them only subjective responses of the participants.

An observational study of ten participants in the study underwent orthodontic treatment with no complications. (1) intakes of several nutrients before and after the addition of orthodontic appliances to patient's mouths. The p-values shown are the result of a two-tailed, paired t test for the mean nutrient values. In this small sample they showed changes in copper (p-0.0018), manganese (p-0.016). Fiber was also lower by 32% but results were of borderline significance (p-0.09). Fat, carbohydrates and protein are the main calorie contributing nutrients.[1] The before and after treatment values are also listen in the first row of Table 1, protein and total lipids did not show much difference at all whereas carbohydrates did decrease by 19%. However, the values obtained for all three of these nutrients were non-significant.

A cross-sectional study (2) compared an orthodontic group versus a control group in mean nutrient intake. Mean values of BMI, age, height and weight were not significantly different between the two groups ($p > 0.05$). In terms of macronutrients orthodontic patients had significantly greater intakes of total fat ($p = 0.011$), cholesterol ($p = 0.004$), saturated fat ($p = 0.002$), monosaturated fat ($p = 0.04$), polysaturated fat ($p = 0.043$), linoleic fat ($p = 0.039$), linolenic fat ($p = 0.045$) and significantly lower intake of fiber ($p = 0.003$) in comparison with the control group, but consumed a similar number of calories, protein and carbohydrate.[2] Micronutrients were also measured between the groups and it showed that chromium ($p = 0.024$) and betacarotene ($p < 0.001$) intake in the control group was significantly higher than the orthodontic group.

A cross-sectional study (3) of Interviews conducted with orthodontic patients were analyzed and used to identify two major themes (pain experience & dietary change) affecting these patients. Pain experience was divided into duration, intensity, site, use of analgesics and timing. All patients experienced pain after the initial orthodontic appliance placement, ranging from mild to severe and from only 1 day to 2 weeks. Pain was mostly confined to the teeth, only 3 reported soft tissue pain. 7 reported that pain was most severe in the mornings and 3 experienced pain throughout the day, also being present also when eating hard foods. The Theme dietary changes was divided into difficulties in eating and chewing, amount of food eaten, foods that could not be eaten, foods that were eaten more, changes in dietary behavior as a result of the orthodontists advice, and

impacts on health. 9 patients had difficulty in eating hard foods, three had discomfort from food stuck in braces. All were eating less and their diet altered from before treatment. The majority of patients moved to a soft diet, eating foods such as soup, rice, mashed food, boiled vegetables, pasta and bananas. Eight patients reported changing their dies because of instruction given by the orthodontist on what to eat to avoid damaging the orthodontic appliance. Seven reported a healthier diet post treatment, healthy defined as less snacks, avoiding high sugar foods, and maintaining good oral hygiene.

Table 1: Orthodontic Appliance Effects on Patient Nutrition

Study	Study Type	N	Sample Pop. age/gender	Assessment methods	Nutrient Mean Values
Riordan DJ (1997) (1)	Cohort study	10	US 12 - 16 y olds. 3 boys 7 girls	3-day diet journal pre and post treatment	Nutrient / Recommended nutrient levels / Pre / Post / % diff. / P-Value Protein / 52 gm / 79.6 gm / 74.8 gm / -6.4 / 0.71 Total lipids / N/A / 82 gm / 88.9 gm / +8.4 / 0.60 Carbs / 130gm / 319gm / 269 gm / -19 / 0.19 Copper / 890 µg / 1.23 mg / 0.85mg / -45 / 0.0018 Manganese / 410 mg / 2.85 mg / 2.08 mg / -37 / 0.016 Fiber / 28-38gm / 4.47 gm / 3.38 gm / -32 / 0.09
Shirazi et al. (2010) (2)	Cross-sectional study	180	Iranian 15 to 17 y olds. Treatment: 31 boys 59 girls Control: 34 boys 56 girls	'24-hour dietary recall' conducted by trained interviewer	Nutrient / Control group / Orthodontic group / P-Value Total fat (g) / 56.5 / 69.9 / 0.011 Cholesterol (mg) / 166 / 232 / 0.004 Saturated fat (g) / 17.8 / 23.3 / 0.002 Monounsaturated fat (g) / 17.0 / 20.8 / 0.04 Polyunsaturated fat (g) / 16.2 / 20.3 / 0.043 Linoleic fat (g) / 14.1 / 18.1 / 0.039 Linolenic fat (g) / 0.58 / 0.91 / 0.045 Soluble fiber (g) / 0.39 / 0.20 / 0.003 Chromium (mg) / 0.026 / 0.016 / 0.024 Beta-Carotene (Ug) / 278 / 72.1 / <0.001
Al Jawad et al. (2011) (3)	Cross-sectional study	10	4 Caucasian, 4 Asian, 2 Afro-Caribbean 12-14 y olds 4 boys 6 girls	Semi-structured one-to-one interviews 4-6 weeks post appliance placement	<u>Reported findings</u> Ate less Difficulty eating (chewing) Increased pain/discomfort Softer diet over hard food Eating fewer snacks Avoiding high sugar content foods

DISCUSSSION:

The available evidence is from two small and one large observational studies. Despite the fact that two of these studies were quite small (10 subjects each) the effects were strong enough to demonstrate acute changes in diet.

In summary, the cohort study presented by Riordan DJ showed changes in nutrient intake after the addition of orthodontic appliances to patient's mouths. Statistically significant decreases in copper and manganese were seen and general trends were noticed among the other nutrients. Fiber decreased, which follows the expected effects of a change to a softer diet as recommended by orthodontists to avoid discomfort. Patients chose meals with higher fat content and less carbohydrates while following the soft diet. The changes in copper can potentially be a problem as copper is an essential nutrient in the diet. Copper deficiency is rare in the United States, but can manifest as anemia, neutropenia, and bone disease.[1] While copper deficiency is not likely to occur from the decreases noted, it may be a risk factor for orthodontists to consider in patients who are borderline copper deficient. Manganese, also an essential nutrient, is needed in small amounts in the human body. It is present in nuts, whole grain, and vegetables, which could cause discomfort to orthodontically banded teeth.[1] Since there is no RDA value established with manganese, even though the decrease is significant, it most likely will not cause any problems in healthy individuals.

This study suggests the desirability of adding nutrient supplements to patient's treatment plans while they are receiving orthodontic treatment.

The largest study Shirazi et al. (2) clearly demonstrated significantly higher intake of fat and lower intake of fiber when the orthodontic group was compared to the control group. Furthermore, beta-carotene and chromium intakes were lower in the orthodontic group and intakes of saturated, monosaturated, and polysaturated fat and cholesterol were significantly higher in the orthodontic group. Riordian DJ showed an increase in fat as well, although not at a significant level and possibly due to their small sample size, the much larger sample size in Shirazi et al. was able to show a significant difference in fat. Riordian DJ's values reflected a short study time, and alterations in nutrient intake are likely to be more apparent in longer orthodontic treatments.

Limitations of Shirazi et al. however include the two separate study groups. The orthodontic group and control group are different individuals, unlike other studies that compare pre and post treatment on the same person. It was never stated that these groups were at identical nutrient levels before the start of treatment, and therefore the associations between the groups regarding nutrient intake may not be correct as it is difficult to be certain that they are directly related. The validity of the'24-hour dietary recall' method of obtaining information from patients will also depend upon how typical the days of assessment were.

The cross sectional study by Al Jawad et al. (3) did not collect any numerical data but contributes valuable subjective data on dietary intake behavior. As expected, through interviewing the study showed patients who had new orthodontic appliances placed were eating less, had difficulty eating, increased pain/discomfort, ate a softer diet over hard food, consumed fewer snacks, and avoided high sugar content foods. Generalizability is limited as a small study group could lead to outliers misrepresenting orthodontic patients overall. However, these perceptions in combination with the other data can support advising these teenage patients to pay attention to potential nutritive changes in eating behavior, and to provide them with nutritive strategies to address appliance related eating issues. Insuring adequate micronutrient intake in this age group is important. This can be achieved through nutrient supplements at the daily recommendation. Although the study did not address vitamin intake, the mineral levels suggest a general trend. It is a stronger study in terms of patient behavior and what actions patients take when eating with their new orthodontic appliances.

In conclusion, all existing evidence points to the fact that orthodontic appliances alter the patient's diet in generally unfavorable ways that can increased cariogenic risk and reduce the nutritional quality of the diet with regard to both vitamins and minerals at a particularly important time in their development.

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