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CORRELATION BETWEEN PARODONTAL INDEXES AND ORTHODONTIC RETAINERS: PROSPECTIVE STUDY IN A GROUP OF 16 PATIENTS

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SUMMARY

Purpose. Fixed retainers are used to stabilize dental elements after orthodontic treatment. Being it a permanent treatment, it is necessary to instruct patients about a constant and continuous monitoring of their periodontal conditions and a correct oral hygiene. The aim of this study was to highlight the possible adverse effects of bonded retainers on parameters correlated to the health conditions of periodontal tissues.

Materials and methods. We selected 16 patients, under treatment in the Orthodontics Department of University of Bari Dental School, who had undergone a lingual retainer insertion at the end of the orthodontic treatment. The patients were then divided into two groups (Control Group and Study Group) and monitored for 3 and 36 months, respectively. The following indexes were taken into consideration: gingival index (GI), plaque index (PI) and the presence of calculus (Calculus Index, CI), the probing depth and the presence of gingival recession on the six inferior frontal dental elements.

Results. After the observation was carried out, any of the patients showed periodontal sockets and gingival recession. In the Study Group, only 1 patient had a PI score=3, the 7 left had scores between 0.66 and 2.83. In the Control Group, one patient had score=0, the other ones showed values between 0.5 and 1.66. The mean GI in the Study Group peaked at a score of 2.83, the minimum was 0.66; whereas in the Control Group the maximum value was 2 and the minimum 0.66. The CI in the Group Study was between 1 and 2. In the Control Group it was absent in only 1 patient, whereas in the remaining 7, it had a value between 0.3 and 1. The clinical data were studied by means of the Wilcoxon test. We found a statistically significant difference for what concerns the Plaque Indexes (PI) ($P>0.05$) and Calculus Indexes (CI) ($P>0.1$) in both groups, with higher scores in the Study Group, having retainers for 36 months. Any statistically significant difference was calculated for the GI.

Conclusions. We can therefore conclude that patients with lingual retainers need periodontal hygiene and treatment as to prevent, in the course of time, periodontal damages non-detectable in short-term.

Key words: parodontal indexes, orthodontic retainers, Straight-Wire technique, Roth technique.

Introduction

The retainer technique was initially proposed to avoid different drawbacks due to the different types of mechanical contention, both fixed and removable. A retainer is a device whose main component is actually a high-flexibility braided orthodontic wire fixed on the lingual surface of the affected teeth (usually the lower frontal sectors) by means of a light curing composite (1, 2). Differently from rigid restraints, retainers do not

impair the various functions of the stomatognathic apparatus and they are preferable for all those clinical situations which require the stabilization of dental elements and the preservation of the shape of the dental arch (3).
A retainer is most suitable in post-orthodontic cases where, following to the resolution lower incisors crowding, burdened by a high rate of relapse, a long-term contention has to be employed. In order to do so, retainers usually cover the range between elements 4.3 to 3.3 (2, 4, 5).
They are also indicated for the therapy of various anomalies with a high rate of aesthetic impairment of the frontal sector; for this reason the retainer, mainly aimed at the control of rotation or diastema re-opening relapse, involves the section of the arch comprised between 1.3 and 2.3 (6-9).
For what concerns both extrusion and intrusion, a retainer is not only mesio-distally useful for the stabilization of a tooth, but also vertically.
A second groups of cases for which the use of retainers is indicated, is the one of advanced periodontally impaired cases, with high level dental mobility. This device, together with a specific treatment, is useful to prevent dental migrations, eliminate the subjective feeling of instability during chewing; it eases the application of periodontal poultices and it also improves the conservation in time of damaged teeth (6, 10).
The application site and its extent, in these cases, naturally vary according to the position of the dental elements to stabilize, from a minimum of two teeth to the whole arch (3).
A further application is the treatment of traumas with partial or complete dislocation of one or more teeth; in these cases, and in particular in the event of a re-implant, it is very important for the immobilization means to be not only reversible, but also able to leave the function free, thus reducing the risk of ankylosis which would inevitably lead to root resorption (11-13).
Other circumstances exist for which an operator can opt for the use of a retainer: to realize temporary prostheses or space maintainers before applying final measures (10).
The aim of the present study was the short-term and mid-term assessment of parameters correlated to the health conditions of periodontal tissues of lower incisors of patients with fixed mandibular retainers, as to highlight the potential existence of a substantial difference between the values of periodontal indexes in the Control Group, consisting of patients with retainer for 3 months, and a Study Group showing the same retention for a longer period of about 36 months.

Materials and methods

The patients composing our sample were selected among those under treatment at the Orthodontics Section of the Dental School of Bari University.
16 patients were recruited: 11 females and 5 males between the ages of 16 and 20.
The Study Group comprises 8 patients who had fixed lingual retainer for a period of 36 months.
The Control Group consists of 8 patients who had received the same kind of retention 3 months before the beginning of the study. All the patients wore a mandibular retainer realized using a triple-stranded 010 steel wire (5).
The inclusion criteria we used are: same typology of fixed lingual contention, absence of carious cavities and restorations, absence of fractures on anterior mandibular teeth, absence of vicious habits and occlusal interferences and canine bilateral guide, non-smokers.
Furthermore, every patient had started orthodontic treatment only if they were in a concomitant periodontal health and showed an adequate maintenance of their oral hygiene; in reason of this, for each patient, we considered pre-treatment and pre-retention periodontal status as “good”. All the patients were treated in compliance with the Roth multibrackets straight-wire (0.22 x 0.28) technique of in both arches.
Before placing the retainer, an oral hygiene session was performed for all patients, especially for those whose monitoring was prevented by the presence of plaque and calculus.
At the moment of the placing of the retaining

wire, all the patients were instructed to start a meticulous care of their oral hygiene and were also invited not to undergo professional oral hygiene sessions for the whole duration of the study.
The patients were informed about the aim of the study and consent was obtained.
The indexes taken into consideration are shown in Table 1.
All the values were reported in the periodontal file used at the Periodontology Section of the Dental School of Bari University (14-18).

Results

16 patients were included in the study: 11 females and 5 males between the ages of 16 and 20.
The parameters of 96 dental elements were recorded (64 lower incisors and 32 canines). Of the Study Group, 1 patient was treated for a Class III malocclusion; 5 patients showed a Class I malocclusion at the beginning of the treatment with skeletal alterations, and 2 patients were treated for a Class II malocclusion. Of the Control Group, 3 patients had a Class III malocclusion; 3 patients were under treatment for a Class I malocclusion with anterior openbite, while two showed a Class II malocclusion. In the following Table we report the clinical and demographic characteristics of the recruited patients (Table 2).
For both groups, the clinical variables were detected on the lingual surface of all the six anterior mandibular teeth and a mean value was estimated for each patient.
For what concerns the mean score of the Plaque Index (PI), we found in the Study Group only one patient with a score=3, the remaining 7 had scores comprised between 0.66 and 2.83.
In the Control Groups, one patient had score=0, whereas the other ones shoed values between 0.5 and 1.66.
The mean Gingival Index (GI) in the Study Group had its maximum value at score = 2.83, the minimum value was 0.66.
The presence of calculus (CI) in the Study Group had a value comprised between 1 and 2. In the Control Group it was absent in only 1 patient, while in the remaining 7, it had values comprised between 0.3 and 0.1.
None of the examined subjects had periodontal sockets or gingival recessions (Tables 3, 4).
Clinical data were studied by means of the Wilcoxon rank sum test which compares two groups in independent samples.
We found a statistically significant difference for what concerns the Plaque ($P>0.05$) and Calculus Indexes ($P>0.1$) in both groups, with higher scores in the Study Group, with subjects having retainers for 36 months. Any statistically significant difference was found for the Gingival Index.

Discussion

Contention is defined as the phase of orthodontic treatment which aims at keeping teeth in the correct position after active treatment; it is therefore integral part of the same treatment (19). Without a maintenance phase, the orthodontic treatment results virtually instable and may lead back to the pre-treatment condition or to a new malocclusion because of three main problems: a) gingival and periodontal tissues modified by orthodontic treatment need time to reset after removing the retainer; b) soft tissues surrounding the oral cavity exert a pressure which may result in a relapse; c) changes due to physiological growth could alter the teeth alignment (19). Relapse occurs when these forces displace teeth in an unfavourable way compared to their correct position. In order to minimize relapse risks, almost all patients need a maintenance device (19).
It is necessary to differentiate orthodontic relapse from “normal” ageing phenomena affecting the oral cavity.
It is now clearly demonstrated that a crowding in the lower frontal sector is an almost inescapable

Table 1 - Periodontal evaluations.

Löe and Silness Plaque Index (PI) (1964):

Score	Criteria
0	No plaque
1	A film of plaque adhering to the free gingival margin and adjacent area of the tooth which may be seen by using the sample on the tooth surface
2	Moderate accumulation of soft deposits within the gingival pocket, or the tooth and gingival margin which may be seen with the naked eye
3	Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin

Löe and Silness Gingival Index (GI) (1963):

Score	Criteria
0	Normal gums
1	Mild inflammation: slight change in color and slight edema; no bleeding on sampling
2	Moderate inflammation: edema; bleeding on sampling
3	Severe inflammation: marked edema; ulceration; tendency to spontaneous bleeding

Calculus Index (CI): coronal extension of supragingival calculus and the presence of separate patches of subgingival calculus (Greene and Vermillion 1960)

Score	Debris
0	No debris or stain present
1	Soft debris covering not more than 1/3rd of the tooth surface or the presence of extrinsic stains without the debris regardless of surface are covered
2	Soft debris covering more than 1/3rd but not more than 2/3rd of the exposed tooth surface
3	Soft debris covering more than 2/3rd of the exposed tooth surface

The IC results were averaged for all six mandibular teeth and a mean value was calculated for each subject.

Probing Depth (PD):

Measured with a periodontal probe (NC 15, Hu-Friedy, Chicago, Illinois, USA)
Was recorded as the distance from the gingival margin to the apical part of the groove
Three readings have been for tooth (mesiolingual, distolingual and medial)

Value 0: PD ≤ 3 mm: no pocket
Value 1: PD> 3 mm: presence of pockets

Gingival Recession:

Moving the marginal soft tissue apical to the CEJ (CEJ) with exposure of the anatomical tooth root.
It was measured with a periodontal probe (NC 15, Hu-Friedy).
Scores in millimeters were recorded only when the recession was present, ie when the CEJ was visible.

Table 2 - Demographic and clinical characteristics of the two study groups.

		Retainer from 3 months (n=8)	Retainer from 18 months (n=8)
		Average %	Average %
Sex (%)	Male	25	62,5
	Female	75	37,5
Age		17,25	18,12
Angle's Class	I	62,5	62,5
	II	37,5	25
	III	0	12,5
Treatment (%)	Tooth Extraction Surgery	25	37,5
	No Tooth Extraction Surgery	75	62,5

Table 3 - Average values observed in 8 patients in the control group (3 months).

	Plaque Index	Calculus Index	Gingival Index	Periodontal Pockets	Gingival Recession
Patient 1	0	1	1	0	0
Patient 2	0,5	0	0,66	0	0
Patient 3	1,16	0,8	2	0	0
Patient 4	1,6	0,5	1,5	0	0
Patient 5	0,83	0,83	2	0	0
Patient 6	1,66	0,5	1	0	0
Patient 7	1	0,5	0,83	0	0
Patient 8	1,33	0,3	0,66	0	0

Table 4 - Average values observed in 8 patients in the study group (18 months).

	Plaque Index	Calculus Index	Gingival Index	Periodontal Pockets	Gingival Recession
Patient 1	2,83	1	1,66	0	0
Patient 2	3	2	1	0	0
Patient 3	0,66	1	0,66	0	0
Patient 4	2,5	1	1,5	0	0
Patient 5	2	1	1,5	0	0
Patient 6	2	1,16	2,83	0	0
Patient 7	2	1	1,6	0	0
Patient 8	1,33	1,33	1,66	0	0

condition for at least 70% of the Caucasian population.
Retainers bonded from canine to canine are usually manufactured with orthodontic wire (0.10 diameter) to be woven in double or triple strand. The technique provides for the passive adaptation of the wire on a working model. The retainer is then bonded with a jig or another wire applying an adhesive technique providing for the use of composite material. The mechanical features of the stranded wire allow physiological movements of the teeth and prevent enamel fractures due to occlusal forces. Using an elastic system, the stability of the periodontal ligament and an adequate modelling of the wire are granted.
One of the disadvantages to consider is due to a relative difficulty in keeping a correct oral hygiene. The periodontal indexes taken into consideration aim at characterizing the periodontal status of two groups of orthodontic patients.
Many different publications exist on this topic and this adds to the popularity of this research tool thus making its use suitable for a comparative assessment of the patients' periodontal status before and after the treatment (16).
A study (20) was carried out on 32 patients (mean age 25) with fixed, stranded retainer for a period of 9 months, and an equal number of patients for a period between 3 and 6 months. Any significant difference was found for what concerns plaque and gingival indexes among the two groups. The long-term group showed more calculus build-up, higher marginal recession and augmented probing depth.
These findings are similar to the results obtained in our study: the Study Group showed more plaque and calculus build-up than the Control Group, but any substantial difference was found in the gingival index. Any of our patients showed periodontal sockets or gingival recession. This is likely to be due to the short observation time.
Calculus build-up is probably due to the higher presence of retention sites for microbial colonization caused by composite margins near free gums, thus offering a difficult cleaning locus which favours plaque and calculus build-up (21).
The adaptation of the wire on the lingual surface of the tooth is critical and it should be performed with the application of a very subtle layer of adhesive, not to be extended over the 2/3 of the lingual crown.
It is also necessary to pay particular care to ensure the absence of composite in the interproximal areas and near the gingival margin. For further control, it is possible to apply a layer of non-adhesive paint to prevent composite from impregnating these areas.
The increase in gingival recessions affecting lower teeth as documented by Pandis (20) can be explained in various other ways. Even though it may correspond to a higher calculus build-up (22, 23), it seems that in these subjects the direct link between the placing of the retainer and the gingival recession is not probable because of the position of the same recession in most patients. Furthermore, the vestibularizing factor applied on inferior incisors induced by orthodontic treatment has been correlated with diminished levels of clinical attack, thus contributing to recession (9). Even though this hypothesis has not been fully accepted (24, 25), it is possible that the proinclination of mandibular incisors kept with a fixed device for long periods of time may cause loss of attack; however, the investigations which rejected the involvement of proinclination of incisors in the recession did not consider such a long-term presence of a fixed orthodontic retention device on the lingual surface of these elements. It may be opportune to point out that because of the difficulty to follow the same population for a decade, this study comprised different samples with a mean age difference of 9 years. The effect of this age difference may exert a discriminating action while modifying some of the variables recorded in this study.
In general, recession tends to increase with age (26, 27) because of plaque and calculus build-up; the risk of illness causing an alteration of periodontal health increases as well, together with incorrect brushing techniques. Studies correlating brushing techniques and risk of gingival recession focused on maxillary molars and premolars and not on mandibular incisors.

The increase in the probing depth appears not to depend on age, except for heavy smokers and subjects with bad oral hygiene who show an early onset of periodontal disease (26). In the study by Pandis (20), the sample lacked these discriminants and it is more likely that the presence of periodontal sockets is attributable to long-term alterations of tissues caused by retainers.
A study (28) was conducted on the 20-year follow-up of patients who had undergone orthodontic treatment and had been kept in fixed contention with canine-canine retainers.
This study exclusively focused on the calculation of the gingival index. The obtained data did not indicate any negative effect on the patients' periodontal health. It was even highlighted a significant difference between the scores of maxillary gingival index without retainer, and the mandibular ones, with less scores in the mandibular dental elements despite the presence of retainers.
This is probably due to the fact that the patients, informed about the negative consequences on their periodontal health the retainer could have engendered, maintained an adequate home oral hygiene, unconsciously more accurate in the mandibular arch.
This is in line with what claimed by Artun (29) who observed that the retainer could have a positive effect on oral hygiene: "The presence of an orthodontic wire applied with a retentive aim, at short and long term, with plaque and calculus build-up, does not appear to prevent hygiene which results to be adequate even along the gingival margin. In this regard, the motivation, possibly transmitted by the orthodontist while giving the contention device, results to be the main success factor" (30-42).

Conclusions

It is obvious that the orthodontic treatment can aim at correcting malocclusions and preventing their relapse, but it cannot ensure the prevention of potential modifications which physiologically occur over the years. A crowding in a situation of early mix dentition can be corrected, but its resurgence is not the relapse of the precedent situation, but a different evolution connected to maturation phenomena and mouth ageing. This point of view brings a radical change in the approach to the orthodontic patient. This change must proceed through the clinicians' awareness and appropriate information given to patients and their parents; this problem further complicates the issue because in most cases the relationship is mediated, being the majority of patients in their childhood. If considered from this point of view, the problem should provide for a different model of informed consent giving detailed information about the exact type of malocclusion, the possibilities of resolution, relapse risks based on standardized grading and divided according to the contention frequency and difficulty and, finally, the evidence of potential future evolutions of dentition and their differentiation from the treatment relapse, the possible resolution of the issue with a long-term treatment with retainer, inconveniences and risks the retainer can bring (presence of a foreign body in the oral cavity, plaque build-up, possible onset of periodontal disease) as to best guide patients in their choice.
From the analysis of literature and the data obtained in our study, we can conclude that:

- for a period from 3 to 36 months, periodontal damages are minimal;
- for longer observation periods (9-20 years) the insurgence of periodontal sockets and gingival recession is possible.

It is true that after 36 months the presence of plaque and calculus was derisory to such an extent that the migration towards the roots of both the gingival margin and the junctional epithelium was not caused. However, similar studies carried out by different Authors for a longer observational period cannot avert this contingency. We nevertheless mean to advise our patients in favour of a post-retentive treatment with retainer because it is possible to avoid all the risks of the resurgence of a site-specific periodontal disease with a correct oral hygiene. We need to teach patients accu-

rate oral hygiene teaching, training them to the use of dental floss which allows more effective cleaning underneath the retainer.

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