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REVIEW ARTICLE

Aggressive periodontitis diagnosed during or before orthodontic treatment

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Abstract

Objective. The aim was to review the literature on aggressive periodontitis diagnosed during or before the initiation of orthodontic treatment and to propose preventive recommendations before, during and after orthodontic treatment. ***Materials and methods.*** Literature searches of free text and MeSH terms were performed by using PubMed, Embase and the Cochrane Library and the appropriate studies were selected. The retrieved articles were analyzed and the relevant data was tabulated according to different parameters. ***Results.*** A total of 220 articles were found in the preliminary search. Eighteen studies, all case reports, describing 21 cases from this search met all the criteria. The mean age of the reported cases was 21.12 years, all treated with combined periodontal and orthodontic modalities. Most of the reported cases were female. ***Conclusion.*** An interdisciplinary dental team must approve the periodontal health prior to and during the course of the orthodontic therapy. In subjects with periodontal pathology, a periodontal consultation and interceptive/corrective therapy should be performed prior to commencing with orthodontic treatment. Orthodontic treatment should be postponed or replanned in order to shorten treatment duration and reduce the orthodontic forces exerted on the aggressive periodontitis involved dentition.

Key Words: *diagnosis, orthodontics, periodontal disease*

Introduction

The term 'aggressive periodontitis' was first introduced at the World Workshop on Periodontal Disease Classification [1]. Previously it was called juvenile periodontitis or early-onset periodontitis and it is characterized by non-contributory medical history, rapid attachment loss, bone destruction and familial aggregation of cases.

Localized aggressive periodontitis (LAgP) causes localized breakdown of the periodontal attachment, in particular parts of the dental arch early in life [1]. Common symptoms are circumpubertal onset and rapid attachment loss in the first molar/incisor area, with interproximal attachment loss in at least two permanent teeth, one of which is a first molar, and involving no more than two teeth other than first molars and incisors. Gingival tissue around the teeth can have normal texture and color, subgingival calculus is not frequent and the periodontal destruction is not consonant with the presence of local irritating agents [2]. Generalized aggressive periodontitis is generalized interproximal attachment loss affecting at least three permanent teeth other than first molars and incisors with pronounced episodic nature of the destruction of attachment and alveolar bone [1]. The attachment loss can result in pathologic extrusion or labial inclination of the incisors, producing esthetic and functional problems for the patient [3–5].

Aggressive periodontitis (both localized and generalized) is usually diagnosed in young populations, mainly by clinical and radiographic examination. Screening tests for children include bite-wing radiographs and periodontal probing tests [6]. Microbiological testing and immunological function tests are less commonly used and can also assist in its diagnosis. The same age of diagnosis is the age orthodontic care is provided to this population.

The first molar, usually involved in aggressive periodontitis, is the first tooth to erupt in the oral cavity. This tooth is frequently in use as an abutment for different active or passive orthodontic appliances from

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Table I. Results of the five search sets of Phase 1.

Search set	Search terms*	No. of articles
1	'Orthodontics' (Medical Subject Heading [MeSH]) or orthodon*	28058
2	periodontit*.tw.	11484
3	periodontos*	441
4	(Step 1 AND 2) OR (Step 1 AND 3)	220
5	Step 4 limited to English, Hebrew, Arabic	188

* The asterisk is a truncation symbol indicating the addition of any letters before the asterisk.

a young age such as distalization appliances (headgear, herbst, pendulum or distal jet), lip bumper, maxillary expanders (Hass or Hyrax appliances), uni/bilateral space maintainers (Nance appliance, transpalatal arch and lingual arch appliances) and fixed orthodontic appliances in which molar bands or tubes may be attached to the first molars of the maxillary and mandibular dental arch. The intimate contact of the orthodontic appliance with the gingival tissue quite often results in increased plaque accumulation and negative influence on gingival health [7–11].

Since aggressive periodontitis usually develops during adolescence and during this period orthodontic treatment is common with frequent visits to the orthodontic clinic, it would be intuitively logical to call upon the orthodontist, in full co-operation with the periodontist, to screen patients for early signs of aggressive periodontitis and initiate interceptive measures when needed.

In order to examine the prevalence of aggressive periodontitis diagnosed during or before the initiation of orthodontic treatment and to draw attention to preventive recommendations before, during and after orthodontic treatment based on this data, we reviewed clinical studies, case reports and reviews that described aggressive periodontitis that developed during orthodontic treatment or aggressive periodontitis which included orthodontic treatment in its treatment protocol.

Literature search

A computerized search of the literature was conducted independently by two reviewers (HHM and DA) using Ovid MEDLINE (from 1948), Embase and the Cochran Library to find articles, published until February 2011, of clinical studies, case reports and reviews dealing with aggressive periodontitis that developed during orthodontic treatment or aggressive periodontitis which included orthodontic treatment in its treatment protocol. Studies concerning aggressive periodontitis with a background of different syndromes, such as Ehlers-Danlos syndrome, were not included. Initially (phase 1), the search encompassed published abstracts with the following combination of keywords: Medical Subject Heading (MeSH) terms ('orthodontics') and free text ('orthodon*', periodontit* and 'periodontos*). The asterisk (*) is the truncation symbol indicating that any addition of letters before the (*) were included in the search. The selection of these terms was done with the help of a senior librarian who specializes in Health Science databases. The searches were confined to publications in English, Hebrew and Arabic.

The following search process was included in phase 1 (Table I). Search set 1 included all articles that are indexed according to the MeSH term 'orthodontics' or the truncation (that is, all articles with words beginning with 'orthodon'). In search sets 2 and 3, we used the truncation 'periodontit' or 'periodontos', respectively. In search set 4, we used the Boolean operators 'and' and 'or' to combine all three sets.

Eligibility of potential studies was determined by reading the title and abstracts of each article identified by the search engine. All the articles that appeared to meet the inclusion criteria on the basis of their abstracts were selected and collected. Secondly, the full-text articles were obtained for manuscripts with missing abstracts or those in which insufficient relevant information was included in the published abstract. Thirdly, the full-text articles were retrieved from the relevant libraries. Reference lists of the included studies were also screened for potentially relevant research. The final selection was independently completed by the two reviewers reading the complete articles and their results were compared. An inter-examiner agreement of 0.93 (inter-examiner Kappa) was obtained. Disagreements were resolved by discussion between the two review authors.

Excel worksheets were designed to list the selected articles and the specific parameters for each case. These parameters included the authors, patients' gender, patients' age at the beginning of the treatment, type of aggressive periodontitis, affected teeth, components of the orthodontic treatment course and the duration of the orthodontic treatment.

Results

Table I presents the phase 1 search results. Search set 4 reduced the number of articles to 220. The final set (set 5) limited the articles to those published in English, Hebrew or Arabic. No articles in this set were in Arabic.

In phase 2 (Figure 1) we determined the eligibility of studies published in articles in English or Hebrew by reading the titles of all 188 articles. As a result, we evaluated the abstracts of 38 articles. Only 18 studies

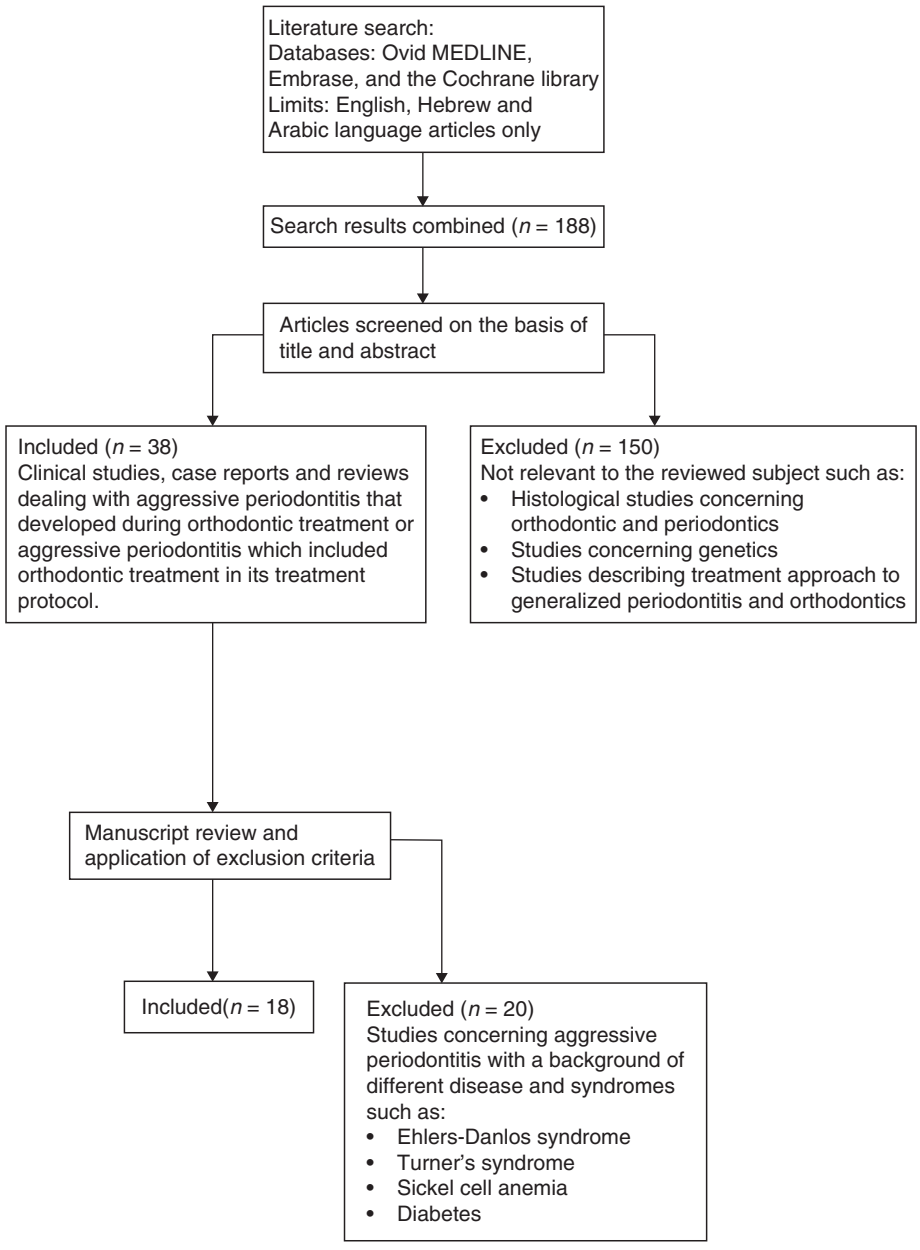

Figure 1. Flow chart of phase 2 literature search.

met the search criteria and were included in this study (Table II).

All of the eligible papers were case reports. No reviews or clinical studies were found. Most of the papers included one reported case and only one paper [12] included four reported cases, totaling 21 cases with a mean age of 21.12 years, all treated with combined periodontal and orthodontic modalities.

Most of the reported cases were female and only five males were reported with aggressive periodontitis [12–15].

Almost all the cases, excluding two [16,17], involved LAgP with typical dentition. The orthodontic treatment focused mainly on closure of extraction spaces [14,18–23] or repositioning of the incisors by intrusion, retraction or uprighting [2,12,13,17,20].

Discussion

The aim of this comprehensive literature review was to study the possible influence of aggressive periodontitis on orthodontic treatment plans, orthodontic appliance assemblies and treatment courses. Although extensive attempts of collecting information relating to this subject were made, most of the papers available in the literature are single case reports, excluding one paper that presents four cases. The lack of high quality case-control studies or randomized controlled

Table II. Information pertaining to 21 reported cases of localized aggressive periodontitis treated with combined periodontal and orthodontic modalities.

Reference	Gender	Age	Type of aggressive periodontitis	Affected teeth	Orthodontic treatment
Closs et al. [18]	Female	24	Localized	Incisors and molars	1. Leveling and alignment starting with small diameter nickel titanium archwires (0.014'').
					2. Closing of extraction space of the maxillary second primary molars.
					3. Maxillary retention by a circumferential Hawley retainer. Mandibular retention by a lingual canine-to-canine fixed retainer.
Zafiropoulos et al. [17]	Female	37	Generalized	All teeth	1. Leveling and alignment.
					2, Intrusion and retrusion of anterior maxillary teeth by 0.017 × 0.025 inch stainless steel archwire until the interdental spaces are closed.
					3. Splinting of all teeth between the mandibular second premolars.
Passanezi et al. [2]	Female	17	Localized	Incisors and first molars	1. Leveling and alignment starting with small diameter nickel titanium archwires (0.012'').
					2. Intrusion of maxillary and mandibular incisors.
					3. Maxillary and mandibular retention by. 00215 coaxial Penta-one archwire and a removable Hawley retainer in the maxilla for night time wear.
Craddock et al. [16]	Female	27	Generalized	All teeth	1. Leveling and alignment with fixed orthodontics.
					2. Fixed retention
Maeda et al. [28]	Female	27	Localized	Incisors and first molars	1. Leveling and alignment starting with small diameter nickel titanium archwires (0.012'')
					2. Maxillary retention by a removable circumferential retainer. Mandibular retention by a canine-to-canine bonded retainer
Venezia et al. [23]	Female	20	Localized	Left madibular first molar and right mandibular second molar	1. Leveling and alignment
					2. Retraction of right mandibular second molar to the location of the extracted right mandibular first molar (due to a wide periapical lesion)
Harpenau and Boyd [21]	Female	16	Localized	First molars	1. Leveling and alignment.
					2. Space closing after extraction of first molars (in 1978) by mesially moving the second and third molars
Okada et al. [14]	Male	17	Localized	Maxillary incisors and first molars	1. Extraction of maxillary first premolars to eliminate dental crowding.
					2. Leveling and alignment starting with small diameter nickel titanium archwires.
					3. Closing of extraction spaces
Stelzel and Flores-de-Jacoby [30]	Female	21	Localized	Mandibular central incisors	Reduction of mandibular central incisors root's proximity (separation of the central incisors)
Worch and Listgarten [15]	Male	30	Localized	First molars and mandibular incisors	1. Extraction of mandibular left incisor due to anterior crowding and inability to maintain proper oral hygiene
					2. Leveling and alignment
					3. Stripping of maxillary incisors and de-rotation of the right maxillary central incisor
Levine and Kutalek [13]	Male	18	Localized	Incisors and first molars	1. Retraction of maxillary and mandibular anterior teeth
					2. Retention by resin bonded retainers

Table II. (*Continued*).

Reference	Gender	Age	Type of aggressive periodontitis	Affected teeth	Orthodontic treatment
Machtei et al. [27]	Female	19	Localized	Left maxillary central and lateral incisors and mandibular molars	1. Removal of orthodontic bands 2. Reshaping of the removable orthodontic appliance in order to eliminate impingement of its parts on the gingival
Folio et al. [12]	Male	32	Post-aggressive periodontitis	3 mm extrusion of left maxillary lateral incisors	1. Intrusion of left maxillary lateral incisor 2. Retention by an upper Hawley appliance
	Male	21	Localized	Maxillary lateral incisors	1. Resolution of an anterior cross-bite involving the maxillary lateral incisors. 2. Retention by a modified Hawley retainer
	Female	28	Post-aggressive periodontitis	Maxillary incisors	1. Repositioning of maxillary incisors 2. Retention using a maxillary Hawley retainer
	Female	16	Localized	Maxillary and mandibular central incisors	1. Intrusion of mandibular central incisors and repositioning of the maxillary ones 2. Retention by upper and lower Hawley appliances
McLain et al. [22]	Female	14.5	Localized	Mandibular incisors, first molars and maxillary left central incisor	1. Space closing after extraction of the affected teeth in 1980 2. Retention by a fixed canine-to-canine retainer with prosthetic replacements cemented in the lower anterior region after the lower arch was constricted
Compton et al. [19]	Female	12	Localized	First molars, mandibular incisors and maxillary left central incisor	1. Leveling and alignment 2. Moving second molars to the extracted first molar's position and the third molars into the second molar's position 3. Moving the right maxillary first premolar to the position of the extracted right maxillary canine 4. Fixed anterior maxillary and mandibular retention
Goldstein et al. [20]	Female	19	Localized	First molar, maxillary lateral incisors and maxillary right premolars	1. Leveling and alignment with light round arches 2. Space closing after extraction of first molars by mesially moving the second and third molars 3. Retraction of maxillary anterior teeth 4. Uprighting maxillary and mandibular anterior teeth 5. Retention by removable maxillary and mandibular retainers
Baer and Everett [25]	Female	13	Localized	Incisors and first molars	Not available
Klingsberg [26]	Female	15	Localized	Maxillary incisors and all first molars	Not available

trials hampered the intention of drawing definitive evidence based on conclusions stemming from this review.

The information mentioned herein summarizes the 21 case reports appearing in the 18 papers. According to Hart et al. [24], the diagnosis of LAgP is based on attachment loss of at least 4 mm of at least two permanent first molars and incisors (one of which is the first permanent molar) in otherwise systemically healthy subjects. No more than two other permanent teeth, beside the permanent molars or incisors, are affected. Fourteen [2,13–15,18–23,25–28] of the 18 reviewed case reports presented in Table II were found to comply with this definition. The cases presented by Folio et al. [12] also comply with a definition of LAgP, even though they were diagnosed according to an earlier and more general definition suggested by Baer [29]. Stelzel and Flores-de-Jacoby [30] considered their presented case as LAgP, although there was no molar attachment loss.

It has been consistently reported that aggressive periodontitis affects more females than males

Table III. LAgP considerations which may operatively influence the orthodontic therapy course concept in LAgP patients regarding this critical review.

Consideration	Operative effect on orthodontics
Early diagnosis and awareness	Gingiva in the earlier stages of LAgP disease appears quite normal and mere clinical inspection does not always reveal the presence of pockets and alveolar destruction [25] Radiographic examination should be performed at least once a year during routine orthodontic treatment [25,47,48]
In case of LAgP diagnosis during or before orthodontic treatment	Immediate orthodontic treatment discontinuation [27] Removal of the orthodontic appliance and forces should be mandated to improve the periodontal outcome [49] Prevent LAgP progression by referral for appropriate conservative periodontal therapy [49] Adjunct antibiotics and antiseptics are recommended [12,13,17,18,23,27,30]
Combined orthodontic periodontal planning of LAgP	Risk management experts should stress that patients with periodontal destruction pose potential liability problems [49,50] Periodontal surgery in the appropriate cases is indicated rather than extraction of affected teeth [22] Extractions are usually indicated for severe cases to eliminate periodontal defects but may be a useful adjunct in specific orthodontic diagnosis such as crowding, anteroposterior dental malrelationships or bimaxillary dental protrusion [22]
Time lag between LAgP diagnosis and future orthodontic treatment	3 month delay of orthodontic movement is recommended: to allow proper bone healing time to ensure maintenance of proper tooth attachment and support during and after tooth movement [19,49], to prevent reinvolvement of the newly positioned teeth into an aggressive periodontitis site [20] Orthodontic treatment may resume only under the close follow-up and recommendations of the pedodontist, periodontist and orthodontist team [49]
Future orthodontic treatment objectives in LAgP	May eliminate inflammatory factors by creating access for proper oral hygiene and altering occlusal factors [51] May be part of the conservative periodontal techniques for repositioning and intrusion of affected incisors with marginal bone loss and uprighting tipped affected molars to resolve extensive bone loss [38,51–54] A new connective tissue attachment can also be formed during intrusion of periodontally involved teeth if gingival inflammation is eliminated and root surfaces are adequately scaled [51] May include space closing due to LAgP affected molar extraction [14,18–23]
Magnitude of the future orthodontic force	Lighter orthodontic forces should be applied on teeth with compromised bone support because they can move easily; heavier forces can negatively affect the periodontal membrane [51,55] Light wires, i.e. 0.012" and 0.014" nickel-titanium, are recommended when initiating orthodontic treatment during the leveling and alignment stage [2,14,18,28] Low friction, passive self-ligating brackets with long activation spans to exert low forces may be recommended [56]
Control of the future orthodontic force and anchorage	The employment of mini-implants for improved anchorage and force control is suggested [57] The interval of orthodontic force activation should also be longer, due to periodontal ligament recovery lag, i.e. the remodeling of the periodontal tissues will be longer in aggressive periodontitis cases than in healthy periodontal tissues [38–41]
Future conservative orthodontic treatment duration	The duration of the conservative, non-extraction orthodontic approach in aggressive periodontitis cases will span over 20 months [2,14,17,18,28]
Orthodontic retention	The use of removable in place of fixed retainers should be considered, although they are highly dependent on the patient's co-operation, due to their possible positive influence on plaque accumulation and gingival inflammation [7] Clear vacuum formed retainers which mainly involve occlussal crown attachment with negligible gingival contact are preferable in maintaining proper oral hygiene over Hawley retainers [42–46], whose Adams claps and ball attachment increase subgingival plaque accumulation around bearing teeth and cause mechanical gingival irritation [58]

[29,31–33]. This gender difference is also reflected in our review, as only five of the 21 cases are males.

In all the reported cases the diagnosed aggressive periodontitis was treated using an interdisciplinary approach combining periodontal and orthodontic modalities. However, excluding the cases reported by Venezia et al. [23], Machtei et al. [27] and Baer and Everett [25], all the presented patients suffered from aggressive periodontitis prior to the initiation of the orthodontic treatment. In these cases, intense orthodontics aimed to improve the effect of the disease on the dentition (i.e. space closure after

extraction of affected teeth, retraction of flared teeth, improvement of bone volume and crown-root ratio of affected teeth), while the periodontal treatment dealt with the etiology of aggressive periodontitis. Venezia et al. [23], Machtei et al. [27] and Baer and Everett [25] presented the only cases found in the literature search, where LAgP was diagnosed and developed during or close to the end the orthodontic treatment. Clinical inspection of the involved teeth revealed increased mobility and radiographic examination displayed severe alveolar bone loss. Only in the case reported by Machtei et al. [27] was the orthodontic treatment discontinued immediately with the diagnosis of LAgP. A removable orthodontic retainer was then applied. In the other two cases, LAgP was diagnosed soon after completion of the active orthodontic treatment during routine radiographic examination and therefore removal of any appliance was not indicated. In contrast to the reviewed cases, the orthodontic treatment in these three cases was not part of the LAgP treatment course (i.e. the orthodontic treatment in these cases was not aimed to treat LAgP results or the disease symptoms), but was performed as part of a distinct orthodontic plan without any connection to LAgP and prior to its diagnosis.

We anticipated many more studies in this literature review pertaining to the diagnosis of aggressive periodontitis during the course of regular orthodontic treatment due to the similarity of both onset ages. A possible reason for the scant number of reports on aggressive periodontitis occurring during the orthodontic treatment course might be that the dental community and orthodontic specialists themselves mistakenly attribute aggressive periodontitis symptoms directly to the destructive process occurring in the periodontal membrane along the orthodontic treatment course. However, the early manifestation of clinically detectable lesions in aggressive periodontitis is generally interpreted as an expression of highly virulent causative agents or high levels of susceptibility of the individual patient, or a combination of the two [34]. Some of these agents are Actinobacillus actinomycetemcomitans (A.a., now termed Aggregatibacter actinomycetemcomitans), Capnocytophaga sp., Eikenella corrodens, saccharolytic Bacteroides-like organisms now classified as Prevotella sp. and motile anaerobic rods today labeled Campylobacter rectus [35]. Other factors such as genetic factors [36] and smoking [37] were also linked. Unfortunately, LAgP might result in unplanned extraction of the affected teeth. Personal communication with orthodontists revealed that they might consider this type of unpleasant incident to be a failure on their part, in addition to the difficulties in convincing the patients, their parents and dental colleagues of the blamelessness of the orthodontic process in this tragic instance. Yet, as presented in the cases of Venezia et al. [23], Machtei et al. [27] and Baer and Everett [25], the onset of aggressive periodontitis is not caused by orthodontic therapy, although it may occur coincidentally with, or shortly subsequent to, the initiation of orthodontic treatment [25].

Table III summarizes the considerations which may operatively influence the orthodontic therapy concept in LAgP patients regarding this critical review. The awareness of the orthodontists of LAgP pathology is crucial to their ability to diagnose it from its onset and prevent its progression by referral of the patient for conservative periodontal therapy, adjunct antibiotics and antiseptics as well as periodontal surgery in the appropriate cases [22], rather than extraction of the affected teeth.

In such cases of combined orthodontic treatment and aggressive periodontitis, an interdisciplinary dental team including a pedodontist, a periodontist and an orthodontist must approve the periodontal health and the orthodontic patient's capability to keep adequate oral hygiene prior to and during the course of orthodontic therapy. The patients and their parents must be aware of this team protocol. In subjects with LAgP where pathologic pockets are observed or bone loss is detected, prior to commencement of orthodontic treatment, an interceptive/corrective periodontal therapy should be performed immediately prior to any orthodontic intervention. Severe cases may warrant orthodontic treatment re-planning in order to reduce the orthodontic forces exerted on the aggressive periodontitis dentition involved. The interval of orthodontic force activation should also be longer, due to periodontal ligament recovery lag, i.e. the remodeling of the periodontal tissues will be longer in aggressive periodontitis cases than in healthy periodontal tissues [38–41]. In case of extractions, a 3-month delay of orthodontic movement of adjacent teeth into an aggressive periodontitis extraction site after extraction might be recommended to prevent re-involvement of the newly positioned teeth [20] and to allow proper bone healing to ensure maintenance of proper tooth attachment and support during and after tooth movement [19]. These cases will also require continued frequent periodontal/pedodontic follow-up, including periodontal and radiographic examination (vertical bite-wing) in a 3-month interval along the orthodontic therapy period.

The use of removable in place of fixed retainers, as indicated in most of the reported cases, should be considered, although they are highly dependent on the patient's co-operation, due to their possible positive influence on plaque accumulation and their negative influence on gingival inflammation [7]. The clear vacuum formed retainer is a type of appliance which mainly involves occlussal crown attachment with negligible gingival contact and therefore decreases the risk of plaque accumulation and gingival irritation [42]. In light of the fact that this type of retainer assists in maintaining proper oral hygiene

[43–45], it should be recommended for use in these cases [46].

Future prospective randomized controlled studies on orthodontic patients suffering from aggressive periodontitis are warranted to add valuable information and convincing evidence to show the true relationship between aggressive periodontitis and the outcome of orthodontic therapy.

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