Standards for Case Reports Regarding Gummy Smile Treatment in Literature: A Systematic Review

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Abstract

Background: Excessive gingival display, also known as gummy smile, represents a serious aesthetic problem that could be related to various etiological factors. In terms of case reports, several treatment methods are demonstrated in the literature as solutions for such issue.

Aim: This PubMed-based systematic review aimed at finding out whether case reports in literature follow regular standards in demonstrating gummy smile cases.

Methods: An online search of case reports in PubMed during the last ten years was conducted using specific terms in combination: Gingival-display or gummy-smile or asymmetric-smile or gingival-exposure and Treatment. Exclusion criteria were carefully followed.

Results: Thirty-three papers were included in the review. The degree of gingival exposure that was considered as gummy smile varied among papers. The most common factor for the origination of gummy smile was related to mixed oro-facial/orthognathic/ or undefined skeletal factors. Pure orthodontic treatment and orthognathic corrective surgeries were the most methods of choice for gummy smile correction. There was no consensus regarding how to express the success or improvement of cases after treatment, and no standards for setting a follow-up period seemed to be appointed.

Conclusion: There is no consensus on how to demonstrate a case report dealing with gummy smile treatment. A unified form with standard rationales when case reports regarding gummy smile are to be conducted is utterly needed.

Keywords: Gummy smile; Systematic review; Case report; Treatment

Introduction

Excessive gingival display/ exposure, also known as “Gummy Smile” (GS), is an embarrassing issue for many people from a psychological and social point of view. Such people always seek any possible treatment to correct this esthetic problem [1]. A patient is considered as having such an aesthetic problem when more than 2 mm of gingival tissues, measured from the lower margin of upper lip to the free gingival margin, are shown on a static maximum smile [2,3].

Reasons for excessive gingival exposure may be related to muscular, gingival, skeletal factors, or a combination thereof. Thus, a gummy smile may be caused by a short upper lip, short crowns on the upper front teeth, vertical maxillary excess, gingival hypertrophy or hyperactivity of the elevator muscles of the upper lip [4-6].

A suitable classification of GS would also be related to the aetio-pathogenic factors. For example, a high smile line, as defined by Peck [7] can be categorized as one of the following types: Dentogingival, due to an altered dental eruption with consequent reduction in clinical crown exposure; muscular, caused by hyperactivity of the perioral muscles; dento-alveolar, resulting from excessive sagittal and vertical growth of the upper jaw; and, finally, mixed, arising from a number of associated causal factors.

The methods of treatment for GS are highly dependent upon the causative factors. Those methods include orthodontic, surgical, or combined ortho-surgical treatments. The injection of Botulinum Toxin Type A (BOTOX-A) is also considered effective when GS is caused by hyperactivity of perioral muscles. However, there is a lack in literature regarding the long-term results of each type of treatment.

In the literature, most of scientific papers regarding the topic of GS are demonstrated as case
reports not as controlled studies. This gives case reports higher privilege when dealing with GS in the literature. However, unified forms of case descriptions would be ideal.

In this paper, we conducted a Pubmed-based systematic review in order to find out whether case reports in literature follow regular standards in demonstrating GS cases including definitions, reasons, treatment methods, patterns of improvement, and follow-up periods.

Methods

This systematic review included all case reports related to the treatment of GS in the period between April 2010 and April 2020. An online search of PubMed was conducted using the following search terms in combination: Gingival-display or gummy-smile or asymmetric-smile or gingival-exposure and Treatment. To improve the search method, a filter with only “Case Reports” was applied. Full texts of all extracted papers were thoroughly screened after collection using open-access directories; Research Gate uploaded PDF-files, or direct request from the Author(s). Exclusion criteria were reports not specific to gummy smile treatment, reports without detailed description of the treatment technique, review papers, meta-analysis papers, and any other type of papers that are not case reports. Moreover, the inability of obtaining the full text of any case report was a direct exclusion criterion. The author reviewed all articles and, based on the exclusion criteria, agreed on the final selection of articles for review.

Results

The initial search on PubMed yielded 47 articles. Of these, 14 were discarded based on exclusion criteria; namely 8 papers with no full text accessibility, 2 reviews, 2 papers that were not directly related to GS topic, 1 letter to editor, and 1 consensus report. Therefore, 33 papers were included in our review (Figure 1).

The degree of gingival exposure that was considered as GS varied among papers. Whereas 21 papers only used the terms “excessive gingival display” or “gummy smile” without a direct measurement, other papers referred to GS when an exposure of 4.5 mm, 4 mm, >4 mm, 3 mm or more, 2 mm to 8 mm, 2 mm to 4 mm, 4.5 to 6 mm, 7 mm (in 2 papers), 6 mm (in 2 papers) was detected. Only one case report used the term “gummy face”.

Reasons of GS mentioned in the extracted case reports were: mixed oro-facial/orthognathic/undefined skeletal factors (6 papers), Vertical Maxillary Excess (VME) (5 papers), protrusive maxilla (3 papers), Hypermobility of Upper Lip (HUL) (2 papers), VME with HUL (2 papers), supra-erupted maxillary anterior teeth (2 papers), altered passive eruption with HUL, Bi-maxillary dental protrusion, and short upper lip with VME. Ten papers did not mention the exact reason(s) of the diagnosed GS.

Regarding the treatment methods used in the case reports, it was shown that pure orthodontic treatment was used in 10 papers, orthognathic corrective surgery (9 papers), BOTOX-A injection (3 papers), Lip Repositioning Surgery (LRS) (3 papers), Crown Lengthening (CL) (2 papers), modified LRS (2 papers), as well as gingivoplasty, muscular transaction, V-Y plasty procedure, and laser-assisted LRS with CL.

The degree of improvement after a specific treatment procedure was expressed in the case reports in different ways. Some papers used a simple subtraction formula of gingival exposure between (before) and (after) treatment (8 papers). In those papers, the degree of improvement ranged between 0 mm and 4 mm. However, most of papers just used the term “improved” to refer to successful results (22 papers), one paper used the term “adequate gingival display”, one paper mentioned that the GS was “not completely corrected”, and one paper claimed that the improvement was 43%, 29%, and 21% at 1, 3, and 6 months post-treatment respectively.

The average follow-up periods stated in the extracted case reports with “stable results” were 12 months (6 papers), 36 months (4 papers), 6 months (3 papers), 24 months (2 papers), 60 months (2 papers), 1 month, 18 months, 20 months, 22 months, 30 months, 50 months, and 132 months (11 years). However, 9 papers did not mention any follow-up periods.

Detailed techniques, gingival exposure measurements, improvement degrees, and follow-up periods with stable results are reported in Table 1.

Discussion

The etiological factors of gummy smile have been thoroughly identified by Ezquerra et al. [55]. A GS could be aroused due to “bone” component in case of excess vertical maxilla, “gingiva” in delayed passive dental eruption, and the “muscles” in hyper-functioning upper lip elevators.

Vertical bone excess is usually corrected by a “Le Fort I” surgery [56-59]. Delayed passive eruption leading to short squared teeth has been traditionally treated by dentists using crown lengthening surgery involving gingivectomy, gingivoplasty, or apically positioned flaps with or without bone resection [60,61]. The upper lip muscles hyperactivity has been managed with various techniques, including vestibular mucosa resection [62], myectomy with partial resection of levator muscles [63], and sub-periosteal dissection of lip-elevating musculature [64]. A novel and less invasive approach to treating
Table 1: Summary of treatment techniques and outcomes regarding excessive gingival display.

<table>
<thead>
<tr>
<th>No</th>
<th>Journal and date of publish</th>
<th>Authors</th>
<th>DOI</th>
<th>Type of article</th>
<th>Definition and degree of GS</th>
<th>Reason of GS</th>
<th>Main treatment keys</th>
<th>General description of the treatment</th>
<th>Final result regarding GS</th>
<th>Follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dent Clin North Am. 2020 Apr;64(2):341-349</td>
<td>Dym H et al. [8]</td>
<td>10.1016/j.cden.2019.12.003</td>
<td>Review (EXCLUDED)</td>
<td>-</td>
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<td>2</td>
<td>Am J Orthod Dentofacial Orthop. 2020 Feb;157(2):245-258</td>
<td>Saga AY et al. [9]</td>
<td>10.1016/j.ajodo.2018.09.021</td>
<td>Case report</td>
<td>excessive gingival display on smile (4.5 mm)</td>
<td>Class II, Division 1 malocclusion, exaggerated curve of Spee, a deep overbite (impinging mandibular incisors), noncoincident dental midline lines with the lower being deviated 2 mm to the left</td>
<td>(1) restriction of maxillary growth with cervical headgear, (2) extraction of the maxillary first premolars to reduce the maxillary protrusion and the mandibular second premolars to facilitate Class II dental correction, and (3) management of maxillary incisor intrusion via anchoring with mini-implants.</td>
<td>Orthodontic treatment</td>
<td>an exposure at smiling amount of no greater than 3.0 mm</td>
<td>Treatment results were deemed stable after 5 years of active orthodontic treatment</td>
</tr>
<tr>
<td>3</td>
<td>Clin Adv Periodontics. 2019 Sep;9(3):135-141</td>
<td>Ganesh B et al. [10]</td>
<td>10.1002/cap.10080</td>
<td>Case report</td>
<td>7 mm of gingival display during smile</td>
<td>multiracial etiology (Altered passive eruption + hyperactive LP)</td>
<td>laser-assisted lip repositioning + crown lengthening procedure by gingivectomy</td>
<td>Laser + surgery</td>
<td>3 mm gingival display</td>
<td>maintained at 6 and 12-month follow-up</td>
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<td>4</td>
<td>J Pak Med Assoc. 2019 Sep;69(9):1385-1389</td>
<td>Zafar K et al. [11]</td>
<td>N/A</td>
<td>Case report (EXCLUDED) Not related to GS</td>
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<td>5</td>
<td>Dermatol Online J. 2019 Aug 15;25(8)</td>
<td>Chen G et al. [12]</td>
<td>N/A</td>
<td>Case report (EXCLUDED) Not related to GS</td>
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<td>6</td>
<td>Bull Tokyo Dent Coll. 2019 Jun 21;60(2):139-145</td>
<td>Nojima K et al. [13]</td>
<td>10.2209/tidopublication.2018-0047</td>
<td>Case report</td>
<td>Gummy smile only</td>
<td>Vertical maxillary excess</td>
<td>bilateral mandibular first premolar extraction with two-jaw surgery and genioplasty. Orthodontic treatment with a multi-bracket system, the maxilla was transposed 6 mm upwards by orthognathic surgery and the mandible 17 mm anteriorly and 5 mm upwards by counterclockwise rotation.</td>
<td>Surgical orthodontic treatment</td>
<td>N/A</td>
<td>At 2 years after completion of treatment, occlusion and the maxillofacial morphology remain stable, with almost no relapse</td>
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<td>7</td>
<td>Bull Tokyo Dent Coll. 2019 Jun 21;60(2):115-129</td>
<td>Katada H [14]</td>
<td>10.2209/tidopublication.2018-0041</td>
<td>Report of 2 cases (one of which was related to GS)</td>
<td>Gummy smile only</td>
<td>bimaxillary dental protraction</td>
<td>Orthodontic anchor screws were used to achieve posterior traction and intrusion in the maxillary incisor region to improve the gummy smile.</td>
<td>orthodontic treatment</td>
<td>N/A</td>
<td>N/A</td>
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<td>8</td>
<td>Dermatol Online J. 2019 Jun 15;25(6)</td>
<td>Pedron II [15]</td>
<td>N/A</td>
<td>Letter to Editor (EXCLUDED)</td>
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<td>9</td>
<td>J Craniofac Surg. 2019 May/ Jun;30(3):876-878</td>
<td>Duruel O et al. [16]</td>
<td>10.1097/SCS.0000000000005298</td>
<td>Report of 3 cases</td>
<td>Case 1: mixed gummy smile. Case 2: anterior gummy smile, especially in lateral teeth. Case 3: mild gingival display on left side</td>
<td>Case 1: hyperactivity of the muscles</td>
<td>Case 1: and 2: botulinum toxin-A injection (5 IU) at Yonsei points only one time per site Case 3: Botulinum toxin-A injections were performed 2.5 IU for her right side and 5 IU for her left side at Yonsei points</td>
<td>Orthodontic treatment</td>
<td>botulinum toxin-A injection</td>
<td>Surgical orthodontic treatment</td>
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<td>10</td>
<td>Am J Orthod Dentofacial Orthop. 2019 Apr;155(4):560-571</td>
<td>Rahman F et al. [17]</td>
<td>10.1016/j.ajodo.2017.08.032</td>
<td>Case report</td>
<td>gummy smile</td>
<td>bilateral idiopathic condylar resorption and anterior open bite</td>
<td>(1) pre-surgical alignment and leveling of the teeth in both arches; (2) jaw motion tracking (JMT) to detect mandibular movement; (3) 3-piece maxillary osteotomies with mandibular reconstruction and bilateral coronoidectomies; and (4) postsurgical correction of the malocclusion.</td>
<td>Orthognathic surgery</td>
<td>adequate gingival display was achieved</td>
<td>Twenty-two months after the initiation of orthodontic treatment, the gummy smile and lip incompetency were corrected.</td>
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<tr>
<td>Article ID</td>
<td>Journal</td>
<td>Authors</td>
<td>Case Report Type</td>
<td>GS Description</td>
<td>Treatment Details</td>
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<td>11</td>
<td>Int J Esthet Dent.</td>
<td>Longo E et al. [18]</td>
<td>N/A</td>
<td>Case report (EXCLUDED) No full text available</td>
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<td>12</td>
<td>Int J Esthet Dent.</td>
<td>Aroni MAT et al. [19]</td>
<td>N/A</td>
<td>Case report (EXCLUDED) No full text available</td>
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<td>13</td>
<td>J Cosmet Dermatol.</td>
<td>Bertossi D et al. [20]</td>
<td>10.1111/jocd.12729</td>
<td>Consensus report (EXCLUDED)</td>
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<td>14</td>
<td>Dermatol Online J.</td>
<td>Araujo JP et al. [21]</td>
<td>N/A</td>
<td>Case report Mixed GS maxillary vertical excess such as the contraction of the levator labii superiors Botulinum toxin injection as 2 IU were injected into 2 points of the levator labii superiors and 5 IU into the minor zygomaticus bilaterally</td>
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<td>15</td>
<td>Int J Oral Maxillofac. Surg.</td>
<td>Dilaver E and Uckan S [22]</td>
<td>10.1016/j.ijom.2017.09.015</td>
<td>Case report</td>
<td>3 mm or more of visible gingiva during smile vertical maxillary excess and short upper lip V-Y plasty procedure</td>
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<td>16</td>
<td>Am J Orthod Dentofacial Orthop.</td>
<td>Bae SM et al. [23]</td>
<td>10.1016/j.ajodo.2016.09.034</td>
<td>Case report GS protrusive maxilla Four premolars were extracted, and micro-implant anchorage was used to retract the anterior teeth.</td>
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<td>17</td>
<td>Am J Orthod Dentofacial Orthop.</td>
<td>Ishida Y and Ono T [24]</td>
<td>10.1016/j.ajodo.2016.09.030</td>
<td>Case report GS high-angle skeletal Class II malocclusion normalize overjet and overbite, improve the gummy smile, and establish satisfactory occlusion with stable posterior support. Zygomatic anchorage plates were used to achieve absolute anchorage for distalization and intrusion of the maxillary dentition</td>
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<td>18</td>
<td>Compend Contin Educ Dent.</td>
<td>Littuma GJS et al. [25]</td>
<td>N/A</td>
<td>Case report (EXCLUDED) No full text available</td>
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<td>19</td>
<td>J Craniofac Surg.</td>
<td>Nahm KY et al. [26]</td>
<td>10.1097/SCS.0000000000003716</td>
<td>Case report GS corticotomy in upper palatal area and anterior segmented osteotomy in the mandible An antero-posterior lingual appliance was used to bodily retract the upper anterior teeth, intrusion of upper entire arch using 2 mid-palatal temporary skeletal anchorage devices.</td>
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<td>20</td>
<td>Angle Orthod.</td>
<td>Paik CH et al. [27]</td>
<td>10.2319/101816-753.1</td>
<td>Case report GS vertical maxillary excess Differential intrusion of anterior and posterior teeth in both arches</td>
<td>-</td>
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<td>21</td>
<td>J Coll Physicians Surg Pak.</td>
<td>Khan MN et al. [28]</td>
<td>N/A</td>
<td>Case series gingival display (2 to 8 mm) Bone vertical maxillary excess</td>
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<td>22</td>
<td>Am J Orthod Dentofacial Orthop.</td>
<td>Wang XD et al. [29]</td>
<td>10.1016/j.ajodo.2016.04.034</td>
<td>Case report GS A severe high angle with mandibular retrusion and protrusive maxilla Mini-screw-assisted vertical control, intrusion of both the anterior and posterior segments, and favorable counterclockwise rotation of the mandible.</td>
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<td>No.</td>
<td>J. Clin. Exp. Dent.</td>
<td>Case report</td>
<td>GS</td>
<td>vertical maxillary excess</td>
<td>distraction osteogenesis of right mandibular ramus and bimaxillary anterior segmental osteotomy and corrective orthodontic treatment</td>
<td>Orthognathic surgery</td>
<td>N/A</td>
<td>5-year follow-up</td>
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**Table:**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Case report</th>
<th>GS</th>
<th>vertical maxillary excess</th>
<th>distraction osteogenesis of right mandibular ramus and bimaxillary anterior segmental osteotomy and corrective orthodontic treatment</th>
<th>Orthognathic surgery</th>
<th>N/A</th>
<th>5-year follow-up</th>
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hyper-functional lip muscles is treatment with neurotoxins. Since it is reversible, botulinum toxin injection constitutes an option for temporary correction of GS for patients willing to undertake more invasive and definitive procedures at a later date. Botulinum toxin injections for treatment of excessive gingival display is indicated when the patient presents with gingival display upon smiling that exceeds 2 mm and at least one of the following: (1) the main cause of GS is muscle hyperactivity, (2) the patient opts for the least invasive treatment, (3) the patient requests a temporary treatment while awaiting definitive surgery, or (4) treatment is a complement to surgical treatment.

Our PubMed-based systematic review aimed at summarizing the different techniques used in case reports for GS treatment.

It is not so unlikely to conduct a systematic review out of case reports when no other higher level of evidence is sufficiently available. Although there are few publications aggregating case report results in a quantitative manner [65], there is one study comparing the results of a case report meta-analysis and a meta-analysis including Randomized Control Trials (RCTs) [66]; it showed that both meta-analyses reach similar conclusions in adult Muco-Polysaccharidosis type I (MPS-I).

In our review, the initial search on PubMed yielded 47 articles. However, although the search was assigned to filter in order to choose only case reports, 14 were discarded based on exclusion criteria. Thus 33 case reports were included in the review.

According to the results of this review, no standard definition has been appointed to describe a gummy smile. Whereas some papers mentioned various measurements ranged from 2 mm to 8 mm, other papers referred to GS only using expressional terms like “excessive gingival display” or “gummy smile”. One case report used a novel expression (i.e. gummy face) which was so unlikely in this issue. In the literature, however, excessive gingival exposure, or “gummy smile,” is defined as the display of 2 mm or more of gingival show during full smile while smiling [2,3].

Though it is important in case reports to mention the reason(s) of the studied figure (i.e. the GS), 10 papers demonstrated the cases without dealing with etiological factor(s). On the other side, among other papers, the most common factor for the origination of GS was related to mixed oro-facial/orthognathic/ or undefined skeletal factors. At a next level came VME as a major factor.

As a consequence, the results of this review showed that pure orthodontic treatment and orthognathic corrective surgeries were the most methods of choice for GS correction. In spite of its novelty and promising results, BOTOX®-A injection was not frequently a first choice for treatment. It also seemed that direct intervention on the oro-facial muscles, that are responsible for excessive smiling, did not come as a regular choice, since only one paper used it for treating GS.

There was no consensus regarding how to express the success or improvement of cases after treatment. It just varied between differences in mm and percentages, many papers published in “orthodontic” journals just referred to the improvement of a gummy smile appearance using verbal expressions, but not exact measurements.

While 9 papers did not mention any follow-up periods after applying the treatment method, most papers followed the stability of results up to 12 months, and other follow-up periods varied among papers. It seems that no standards for setting a follow-up period have been appointed yet.

**Conclusion**

This PubMed-based systematic review summarized all case reports
published in the past 10 years regarding gummy smile treatment methods. The definition of gummy smile in all papers was not unified, and moreover, many papers did not give a clear measurement of the gingival display which was considered problematic.

Although many papers did not mention the exact causative factor(s) of gummy smile, most cases were related to oro-facial/orthognathic/undefined skeletal factors or vertical maxillary excess.

Regardless of the exact technique, pure orthodontic treatment and orthognathic corrective surgeries were on top of all methods used to correct the gummy smile. The degree of improvement after treatment of gummy smile was difficult to be summarized due to the wide bias of expressing how every case had been improved. Stable results were documented in most of papers. However, several papers did not give a priority for a follow-up period.

This review shows that, to date, there is no consensus on how to demonstrate a case report dealing with gummy smile treatment. In order to facilitate the systematic analysis of such reports and possible meta-analysis conveyance in the future, we suggest a unified form with standard rationales when case reports regarding gummy smile are to be conducted.

References
Aous Dannan Clinics in Surgery - Oral and Maxillofacial Surgery