



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

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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: Dento-gingival, 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

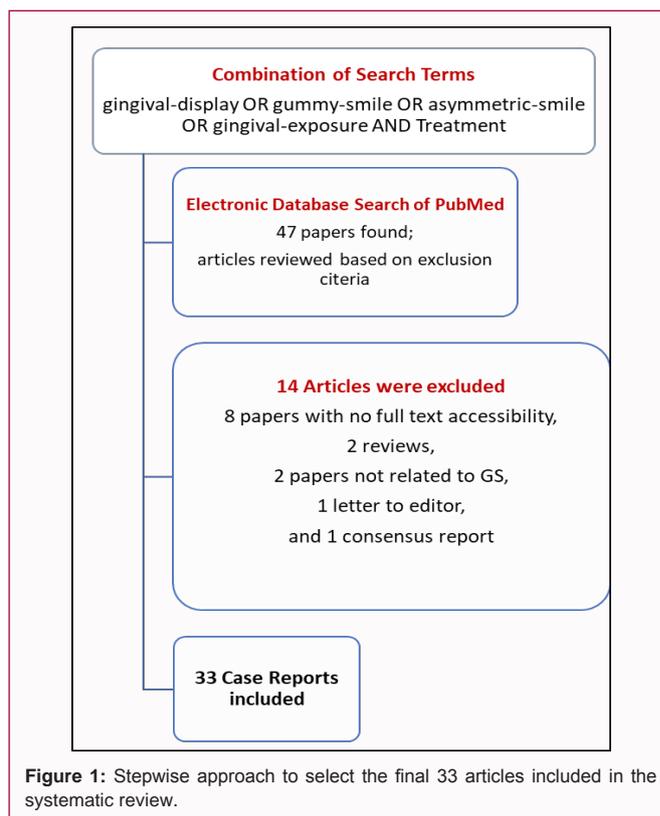
The initial search on PubMed yielded 47 articles. Of these, 14 were discarded based on exclusion criteria; namely 8 papers with no full text accessibility, 2 reviews, 2 papers that were not directly related to GS topic, 1 letter to editor, and 1 consensus report. Therefore, 33 papers were included in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

| No | Journal and date of publish | Authors | DOI | Type of article | Definition and degree of GS | Reason of GS | Main treatment keys | General description of the treatment | Final result regarding GS | Follow up |
|----|--|----------------------|-------------------------------|--|--|--|--|--------------------------------------|---|---|
| 1 | Dent Clin North Am. 2020 Apr;64(2):341-349. | Dym H et al. [8] | 10.1016/j.cden.2019.12.003 | Review (EXCLUDED) | - | - | - | - | - | - |
| 2 | Am J Orthod Dentofacial Orthop. 2020 Feb;157(2):245-258. | Saga AY et al. [9] | 10.1016/j.ajodo.2018.09.021 | Case report | excessive gingival display on smile (4.5 mm) | 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 | (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. | Orthodontic treatment | an exposure at smiling amount of no greater than 3.0 mm | Treatment results were deemed stable after 5 years of active orthodontic treatment |
| 3 | Clin Adv Periodontics. 2019 Sep;9(3):135-141. | Ganesh B et al. [10] | 10.1002/cap.10060 | Case report | 7 mm of gingival display during smile | multifactorial etiology (Altered passive eruption+ hyperactive lip) | laser-assisted lip repositioning + crown lengthening procedure by gingivectomy | Laser + surgery | 3 mm gingival display | maintained at 6 and 12-month follow-up |
| 4 | J Pak Med Assoc. 2019 Sep;69(9):1385-1389. | Zafar K et al. [11] | N/A | Case report (EXCLUDED) Not related to GS | - | - | - | - | - | - |
| 5 | Dermatol Online J. 2019 Aug 15;25(8). | Chen G et al. [12] | N/A | Case report (EXCLUDED) Not related to GS | - | - | - | - | - | - |
| 6 | Bull Tokyo Dent Coll. 2019 Jun 21;60(2):139-149. | Nojima K et al. [13] | 10.2209/tdcpublish.2018-0047 | Case report | Gummy smile only | Vertical maxillary excess | 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. | Surgical orthodontic treatment | N/A | At 2 years after completion of treatment, occlusion and the maxillofacial morphology remain stable, with almost no relapse |
| 7 | Bull Tokyo Dent Coll. 2019 Jun 21;60(2):115-129. | Katada H [14] | 10.2209/tdcpublish.2018-0041. | Report of 2 cases (one of which was related to GS) | Gummy smile only | bimaxillary dental protrusion | Orthodontic anchor screws were used to achieve posterior traction and intrusion in the maxillary incisor region to improve the gummy smile. | orthodontic treatment | N/A | N/A |
| 8 | Dermatol Online J. 2019 Jun 15;25(6) | Pedron IG [15] | N/A | Letter to Editor (EXCLUDED) | - | - | -- | - | - | - |
| 9 | J Craniofac Surg. 2019 May/ Jun;30(3):876-878. | Duruel O et al. [16] | 10.1097/SCS.0000000000005298 | Report of 3 cases | Case 1: mixed gummy smile. Case 2: anterior gummy smile, especially in lateral teeth. Case 3: mild gingival display on left side | Case 1: hyperactivity of the muscles Case 2: Hyperactivity of muscles Case 3: N/A | 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 | botulinum toxin-A injection | The amount of excessive gingival display for each tooth between second premolars was measured less than 3mm, and the percentage of improvement for each case was calculated 100%. | The patients were recalled every month for follow-up visits. The patients demanded the same treatment after 24 weeks to have more aesthetic smiles. |
| 10 | Am J Orthod Dentofacial Orthop. 2019 Apr;155(4):560-571. | Rahman F et al. [17] | 10.1016/j.ajodo.2017.08.032 | Case report | gummy smile | bilateral idiopathic condylar resorption and anterior open bite | (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. | Orthognathic surgery | adequate gingival display was achieved | Twenty-two months after the initiation of orthodontic treatment, the gummy smile and lip incompetency were corrected. |

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|----|--|----------------------------|-------------------------------|--|--|---|--|---------------------------------|--|-------------------------|
| 11 | Int J Esthet Dent. 2019;14(4):384-392. | Longo E et al. [18] | N/A | Case report (EXCLUDED) No full text available | - | - | - | - | - | - |
| 12 | Int J Esthet Dent. 2019;14(4):370-382. | Aroni MAT et al. [19] | N/A | Case report (EXCLUDED) No full text available | - | - | - | - | - | - |
| 13 | J Cosmet Dermatol. 2018 Oct;17(5):719-730. | Bertossi D et al. [20] | 10.1111/jocd.12729 | Consensus report (EXCLUDED) | - | - | - | - | - | - |
| 14 | Dermatol Online J. 2018 Jul;15;24(7). | Araujo JP et al. [21] | N/A | Case report | Mixed GS | maxillary vertical excess such as the contraction of the levator labii superioris | Botulinum toxin injection as 2 IU were injected into 2 points of the levator labii superioris and 5 IU into the minor zygomaticus bilaterally | Botulinum toxin injection | significant decrease of gingival exposure (4mm) after the period of four injection sessions in an overall interval of 20 months | 20 months |
| 15 | Int J Oral Maxillofac Surg. 2018 Feb;47(2):184-187. | Dilaver E and Uckan S [22] | 10.1016/j.ijom.2017.09.015 | Case report | 3 mm or more of visible gingiva during smile | vertical maxillary excess and short upper lip | V-Y plasty procedure | V-Y plasty procedure | the average decrease in anterior gingival display was 43% at 1 month postoperative. However, this rate dropped to 29% at 3 months and to 21% at 6 months | 6 months |
| 16 | Am J Orthod Dentofacial Orthop. 2018 Jan;153(1):108-117. | Bae SM et al. [23] | 10.1016/j.ajodo.2016.09.034 | Case report | GS | protrusive maxilla | Four premolars were extracted, and micro-implant anchorage was used to retract the anterior teeth. | Orthodontic treatment | N/A | N/A |
| 17 | Am J Orthod Dentofacial Orthop. 2017 Nov;153(5):693-705. | Ishida Y and Ono T [24] | 10.1016/j.ajodo.2016.09.030 | 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 | Orthodontic treatment | N/A | 3 years |
| 18 | Compend Contin Educ Dent. 2017 Nov/Dec; 38(10):e9-e12. | Littuma GJS et al. [25] | N/A | Case report (EXCLUDED) No full text available | - | - | - | - | - | - |
| 19 | J Craniofac Surg. 2017 Oct;28(7):e599-e603. | Nahm KY et al. [26] | 10.1097/SCS.00000000000003716 | Case report | GS | N/A | 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. | Orthodontic assisted by surgery | N/A | 1-year follow up |
| 20 | Angle Orthod. 2017 Jul;87(4):625-633. | Paik CH et al. [27] | 10.2319/101816-753.1 | Case report | GS | vertical maxillary excess | Differential intrusion of anterior and posterior teeth in both arches | Orthodontic | N/A | 1-year retention period |
| 21 | J Coll Physicians Surg Pak. 2017 Jul;27(7):447-449. | Khan MN et al. [28] | N/A | Case series | gingival display (2 to 8 mm) | Bone vertical maxillary excess | Lip repositioning | Lip repositioning surgery | 4 mm reduction of GS | N/A |
| 22 | Am J Orthod Dentofacial Orthop. 2017 May;151(5):978-988. | Wang XD et al. [29] | 10.1016/j.ajodo.2016.04.034 | 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. | Orthodontic | N/A | 1 year |

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|----|---|-------------------------------|------------------------------|--|---|---|--|--|---------------------------------|------------------|
| 23 | Am J Orthod Dentofacial Orthop. 2017 Apr;151(4):779-792 | Gao X et al. [30] | 10.1016/j.ajodo.2016.02.034 | Case report | GS | vertical maxillary excess | distraction osteogenesis of right mandibular ramus and bimaxillary anterior segmental osteotomy and corrective orthodontic treatment | Orthognathic surgery | N/A | 5-year follow-up |
| 24 | J Clin Exp Dent. 2018 Apr 1;10(4):e408-e412. | Faus-Matoses V et al. [31] | 10.4317/jced.54721 | Case series | GS | N/A | lip repositioning | lip repositioning | N/A | 1-year follow-up |
| 25 | Int J Periodontics Restorative Dent. 2020 May/ Jun;40(3):457-461. | Duruel O et al. [32] | 10.11607/prd.4465 | Case report | excessive gingival display | N/A | lip repositioning modified according to each tooth | lip repositioning | Gingival display less than 3 mm | 1 month |
| 26 | Int J Esthet Dent. Autumn 2016;11(3):338-54. | Trushkowsky R et al. [33] | N/A | Case report (EXCLUDED) No full text available | - | - | - | - | - | - |
| 27 | Int J Periodontics Restorative Dent. 2016 Mar-Apr;36(2):e33-40. | Xie C and Meng Y [34] | 10.11607/prd.2034 | Case report | Excessive gingival display of 6 mm when smiling | N/A | Crown lengthening | Crown lengthening | N/A improved but still shown | 2.5 years |
| 28 | Compend Contin Educ Dent. 2016 Feb;37(2):114-22. | Bynum J [35] | N/A | Case report (EXCLUDED) No full text available | | | | | | |
| 29 | Dent Clin North Am. 2015 Jul;59(3):703-16. | Arias DM et al. [36] | 10.1016/j.cden.2015.03.007 | Case report | Excessive maxillary gingival display | skeletal origin | Crown lengthening with Digital Smile Approach (DSA) using Keynote (DSA) | Crown lengthening | not completely corrected | N/A |
| 30 | Dent Clin North Am. 2015 Jul;59(3):665-74. | Babar S et al. [37] | 10.1016/j.cden.2015.03.002. | Case report | GS | N/A | soft tissue laser reduction with supportive measurements (ortho, resto...) | gingivoplasty | N/A | N/A |
| 31 | J Craniofac Surg. 2015 May;26(3):e240-4. | Kang DY et al. [38] | 10.1097/SCS.0000000000001545 | Case report | GS | skeletal origin | Pre-surgical orthodontic treatment, a Le Fort I osteotomy with anterior segmental osteotomy, a bilateral sagittal split ramus osteotomy, and postsurgical orthodontic treatment. | Orthognathic surgery | N/A | N/A |
| 32 | Angle Orthod. 2014 Sep;84(5):910-8 | Kim SJ et al. [39] | 10.2319/080713-587.1 | Case report | GS | supra-erupted maxillary anterior teeth | intrusion of retroclined maxillary incisors in the Class II div2 | Orthodontic treatment | N/A | 50 months |
| 33 | Am J Orthod Dentofacial Orthop. 2014 Jan;145(1):85-94. | Nishimura M et al. [40] | 10.1016/j.ajodo.2012.06.022 | Case report | GS | excessive eruption of the maxillary incisors | temporary anchorage devices combined with miniplates and a miniscrew, | Orthodontic treatment | N/A | 2 years |
| 34 | Int J Orthod Milwaukee. 2014 Winter;25(4):63-6. | Singh H et al. [41] | N/A | Report of three cases (EXCLUDED) No full text available | - | - | - | - | - | - |
| 35 | J Craniofac Surg. 2013 Nov;24(6):2068-72. | Ohba S et al. [42] | 10.1097/SCS.0b013e3182a41b66 | Case report | Gummy face | N/A | conventional Le Fort I osteotomy and following corticotomy at the anterior region of the maxilla. Subsequently, the anterior segment is continuously compressed (compression osteogenesis) in a posterior superior direction followed by orthodontic | Surgery and orthodontic | N/A | 18 months |
| 36 | Am J Orthod Dentofacial Orthop. 2013 Sep;144(3):455-65. | Tavares CA et al. [43] | 10.1016/j.ajodo.2012.09.025. | Case report | GS | N/A | combination of periodontal-endodontic-orthodontic therapy and orthognathic surgery | orthodontic therapy and orthognathic surgery | N/A | 11 year |
| 37 | Int J Periodontics Restorative Dent. 2013 May-Jun;33(3):309-14. | Ribeiro-Júnior NV et al. [44] | 10.11607/prd.1325 | 2 case reports | GS 7 mm showing gingiva 6 mm | Hyperactive upper lip Altered passive eruption | Lip repositioning modified by Rosenblatt and Simon Lip repositioning modified by Rosenblatt and Simon and gingivectomy | Lip repositioning | 6 mm reduction 4mm reduction | 6 months |
| 38 | J Plast Surg Hand Surg. 2013 Apr;47(2):102-5 | Barbosa MV et al. [45] | 10.3109/2000656X.2012.741526 | 2 case reports | GS | N/A | Transection of the depressor septi nasi muscles during standard blind rhinoplasty | Surgery (muscles transections) | N/A | N/A |

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|----|---|----------------------------|------------------------------|--|--|---|--|--|---|-----------|
| 39 | Acta Med Okayama. 2013;67(1):55-60. | Shimo T et al. [46] | 10.18926/AMO/49257 | Case report | 11-mm gingival exposure during full smile | N/A | horseshoe osteotomy with a Le Fort I osteotomy | Orthognathic surgery | N/A | 3 years |
| 40 | J Mich Dent Assoc. 2012 Dec;94(12):40-3. | Livada R and ShiloahJ [47] | N/A | Review (EXCLUDED) | - | - | - | - | - | - |
| 41 | Kathmandu Univ Med J (KUMJ). 2012 Jul-Sep;10(39):88-92. | Hegde M et al. [48] | 10.3126/kumj.v10i3.8029 | Case report | GS | vertical maxillary excess | Fixed Orthodontic therapy and Orthognathic surgery | Fixed Orthodontic therapy and Orthognathic surgery | N/A | 3 years |
| 42 | N Y State Dent J. 2012 Apr;78(3):26-31. | Kasagani SK et al. [49] | N/A | Case report (EXCLUDED) No full text available | - | - | - | - | - | - |
| 43 | Angle Orthod. 2012 Jan;82(1):170-7. | Kaku M et al. [50] | 10.2319/020711-86.1. | Case report | GS | Class II maxillary protrusion | Orthodontic mini-screws | Orthodontic treatment | N/A | 36 months |
| 44 | Am J Orthod Dentofacial Orthop. 2011 Jul;140(1):97-105. | Shu R et al. [51] | 10.1016/j.ajodo.2011.01.021. | Case report | gummy smile with more than 4 mm of gingival exposure in the incisor region | excessive protrusion of the maxillary anterior dento-alveolar complex | Orthodontic maximum retraction of the maxillary anterior teeth with Temporary anchorage devices (TADs) in the posterior dental region were used as anchorage | Orthodontic treatment | N/A | N/A |
| 45 | J Contemp Dent Pract. 2011 Jan 1;12(1):68-72. | Zavanelli AC et al. [52] | N/A | Case report (EXCLUDED) No full text available | - | - | - | - | - | - |
| 46 | J Periodontol. 2010 Dec;81(12):1858-63. | Humayun N et al. [53] | 10.1902/jop.2010.100292 | Case report | gingival display ranged from 2 to 4 mm | vertical maxillary excess and hypermobility of the upper lip. | Mucosal Coronally Positioned Flap | Lip repositioning | significant reduction of gingival display | 1 year |
| 47 | Prog Orthod. 2010;11(1):76-82. | Gracco A and Tracey S [54] | 10.1016/j.pio.2010.04.004. | 3 Case reports | gingival display ranged from 4.5 to 6 mm | N/A | Botulinum toxin injection | Botulinum toxin injection | 0 mm of gingival display | N/A |

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 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.

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