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## Borderline patients: orthodontics or surgery? A literature review

**Peer review status:**

No

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**Article ID:** WMC005580

**Article Type:** Systematic Review

**Submitted on:** 12-Jun-2019, 11:30:32 AM GMT **Published on:** 27-Jun-2019, 12:04:17 PM GMT

**Article URL:** [http://www.webmedcentral.com/article\\_view/5580](http://www.webmedcentral.com/article_view/5580)

**Subject Categories:** ORTHODONTICS

**Keywords:** borderline patients, camouflage, orthognathic treatment, sagittal malocclusions, vertical malocclusions, transversal malocclusions

**How to cite the article:** Vompi C, Germano F, Carreri C, Filetici M, Da Mommio L, Grenga C. Borderline patients: orthodontics or surgery? A literature review. WebmedCentral ORTHODONTICS 2019;10(6):WMC005580

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**Source(s) of Funding:**

None

**Competing Interests:**

None

# Borderline patients: orthodontics or surgery? A literature review

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## Abstract

Borderline subjects are defined as those patients whose malocclusion can be treated either with orthodontic dental compensation (camouflage) or with surgical treatment of repositioning of the jaws in the three planes of the space. A correct diagnosis is one of the most difficult decision for orthodontic clinician. The parameters found at the extra-oral, intra-oral, frontal and lateral clinical examination must be related to the cephalometric data, in order to make a diagnosis and to choose a treatment of tooth skeletal malocclusions. The aim of this review was to delineate diagnostic measures in borderline patients with sagittal or transversal or vertical malocclusion and to compare the treatment effects between them. The scientific research was conducted by using two different databases: Pubmed and Google Scholar. Articles published from 1972 and 2019 were selected. A combination of the following search terms was used: *borderline, class III, class II, open bite, deep bite, cross bite, scissor Bite, malocclusion, camouflage, surgical, treatment*. 12 articles were considered valid, according to inclusion and exclusion criteria. As results, the diagnostic and the treatment plan in cases of borderline patients depend on the knowledge of different and specific parameters. Aesthetic and psychological factors seem to be the main decision parameter. In particular, the information allows the patient to be an important influence in the choice of treatment plan. Further studies are required in order to establish a standard value of the orthodontic variables considered.

## Background

The boundary line between orthodontic and surgical patients is not always so clear. Between the two extremes are those cases defined as borderline which can be treated either with orthodontic dental compensation (camouflage) or with surgical treatment of repositioning of the jaws in the three planes of the space. A correct diagnosis of borderline patients is one of the most difficult decision for orthodontic clinicians. The clinical examination is decisive in the choice of the treatment: orthodontic or surgical. The

parameters found at the extra-oral, intra-oral, frontal and lateral clinical examination must then be related to the cephalometric data. The cephalometric examination of the hard and soft tissues of the dental-maxillofacial complex, performed both on the telerradiography of the skull in lateral-lateral and postero-anterior projections, has a key role in the diagnosis and treatment of tooth skeletal malocclusions. A contextual evaluation of the maxillofacial surgeon is important for achieving the optimal result. The evaluation involves diagnostic, prognostic and therapeutic purposes. The best therapeutic plan and the prognosis also are usually uncertain. Pre-surgical orthodontic treatment sets conceptually different objectives totally opposed to those of a conventional orthodontic treatment. Therefore, to establish preliminary therapeutic plan, whether orthodontic or surgical, is very important. Borderline disorders can present themselves in the three-dimensional plans: sagittal one, transversal one and vertical one. The aim of this review was to delineate diagnostic measures in borderline patients with sagittal or transversal or vertical malocclusion in order to choose a proper treatment and also to compare the treatment effects between them.

## Materials and Methods

The scientific research was conducted by using two different databases: Pubmed and Google Scholar. Articles published from 1972 and 2019 were selected. A combination of the following search terms was used: *borderline, class III, class II, open bite, deep bite, cross bite, scissor Bite, malocclusion, camouflage, surgical, treatment*. Original articles, literature reviews, randomized studies, case-control studies were included. Only articles about the orthodontic choice between orthodontic or surgical treatment were included. Case report, syndromic patients' studies were excluded.

## Review

As results, 12 articles were considered valid. As regards class III malocclusions, six articles were found. Rabie et al in 2008 suggested that patients with

Holdaway angle less than 12 degrees would require surgical treatment, while patients with Holdaway angle greater than 12 degrees can be successfully treated by orthodontics camouflage (1). A study conducted in 2011 by Benyahia et al. indicated the Holdaway H angle as the most conclusive parameter to differentiate between orthodontic and surgical Class III. Its predictive power is 87.2%. Patients with Holdaway angles above a value of 7.2 degrees, can be successfully treated with orthodontic camouflage (2). Eslami et al, in 2018, delineated diagnostic measures in borderline class III cases for choosing proper treatment. It was found that patients with a Holdaway angle greater than 10.3 would be treated successfully with camouflage orthodontic treatment, while patients with a Holdaway angle of less than 10.3 degrees, should be treated with orthognathic surgery. It was also showed that wits appraisal greater than -5.8 mm would be corrected by camouflage orthodontic treatment and less than -5.8 mm should be treated by orthognathic surgery (3). In 1992 Kerr et al. established a value of -4 degrees for angle ANB, 83 degrees for the inclination of the lower incisors to the mandibular plane and 3-5 degrees for the Holdaway angle as the threshold of possibility to use orthodontic appliances (4). Although the four studies showed the importance of Holdaway angle values for the choice of the treatment, a difference between the results of Rabie et al. and Benyahia et al. in estimation of the threshold value resulted. In another study, Martinez et al, in 2016, established some variables such as wits appraisal, lower incisor inclination and inter-incisal angle indicative of orthodontic camouflage or orthognathic surgery. A correlation between the ANB angle and lower incisor inclination before treatment was found, but only in the cases treated by orthognathic surgery (5). Finally, Stellzig Eisenhauer A et al, in 2002, indicated the following 4 variables as the most decisive parameters: wits appraisal, SN, M/M ratio, and lower gonial angle. Wits appraisal was -7.21 mm compared with -4.76 mm in the correctly classified nonsurgery patients and -12.97 mm in the correctly classified surgery patients. The length of the anterior cranial base was shorter in surgery group. The lower gonial angle mean was 80.37 degrees in surgical group, 75.46 degrees in nonsurgical group (6). As regards class II malocclusions, four articles were found. Raposo et al, in 2018, found surgical orthodontic treatment to be more effective for skeletal measurements (ANB, SNB) and convexity of the soft tissue profile including the nose (N0-Pn-Pog0). However, camouflage treatment may represent an alternative to surgical treatment, in terms of the LL-E-line and profile measurements: convexity of the

skeletal profile (N-A-Pog) and convexity of the soft tissue profile excluding the nose (N0-Sn-Pog0) (7). Cassidy et al, in 1993 found that, on average, orthodontic treatment is appropriate for the adult patient with Class II malocclusion who can be treated either way, whereas orthognathic surgery would be the better choice for more seriously affected patients who need important changes (8). Tucker MR, in 1995, stated that in Class II adolescents who are beyond the growth spurt, surgery is most likely to be needed for successful correction of the malocclusion if the overjet is greater than 10 mm, if the distance from pogonion to nasion perpendicular is 18 mm or more, if mandibular body length is less than 70 mm, or if facial height is greater than 125 mm (9). Thomas PM et al, in 1995, showed the psychosocial factors role as treatment simulation, using a combination of computer images and dental models in determining the patient's selection of a treatment option (10). As regards open bite malocclusions, an article was selected. Reichert I. et al, in 2013 demonstrated that the treatment of AOB with TAD may avoid orthognathic surgery in selected AOB cases as nongrowing skeletal open bite cases that may previously have been treated with orthognathic surgery (11). Nahoum HI in 1976 stated that good vertical facial balance, the ratio between N-ANS and ANS-Me should remain 0.81 constantly. In case of skeletal anterior openbite growth, the ANS-Me length will increase, and the ratio will fall. Between 0.81 and 0.68, the vertical problem can be corrected with orthodontic treatment alone; between 0.68 and 0.65 it can be treated with both orthodontics alone and surgery; below 0.65 it can be treated with surgery (12,13).

## Conclusions

In conclusion, the diagnostic and the treatment plan in cases of borderline patients depend on the knowledge of different parameters. As regards borderline class III malocclusions, holdaway angle and wits appraisal seem to be the main parameters for choosing between camouflage orthodontic treatment or orthognathic surgical treatment (1-4). However, the both threshold value is different between the studies. Values like -4 degrees for angle ANB, 83 degrees for the inclination of the lower incisors, 75.46 degrees for the lower gonial angle, represent the threshold of possibility to use orthodontic appliances (4,6). Length of the anterior cranial base was shorter in surgery group (6). As regards borderline class II malocclusions, orthodontic treatment resulted more effective for skeletal measurements (ANB, SNB) and convexity of

the soft tissue profile including the nose (N0-Pn-Pog0) while camouflage treatment resulted an alternative for profile measurements: convexity of the skeletal profile (N-A-Pog) and convexity of the soft tissue profile excluding the nose (N0-Sn-Pog0) (7). Orthognathic surgery is preferred when the discrepancy between mandible and maxillary is important with an overjet of 10 mm, a mandibular length less than 70 mm, Pg-Na about 18 mm and facial height greater than 125 mm (8,9). Psychological factor, evaluated through treatment simulation, resulted a determinant in the choice between orthodontic camouflage or orthognathic surgical treatment (10). As regards open bite when N-ANS/ANS-Me ratio is below 0.650 is preferred a surgical treatment (12,13). Aesthetic and psychological factors seem to be the main decision parameter. In particular, the information allows the patient to be an important influence in the choice of treatment plan. Further studies are required in order to establish a standard value of the orthodontic variables considered.

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