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Case Report

Dentistry Section

Orthodontic Perspective on Marfan Syndrome: A Unique Case Report

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ABSTRACT

Marfan syndrome is considered a relatively rare genetic disorder that affects the connective tissues in the body. It is caused by a specific mutation in the Fibrillin 1 (FBN1) gene, which is a critical component of microfibrils. The elastic fibres in various connective tissues, composed of microfibrils, are affected in Marfan syndrome. This syndrome is associated with a vast array of clinical features involving the cardiovascular, ocular, musculoskeletal, respiratory, and nervous systems. Skeletal malocclusion is an early and characteristic manifestation of Marfan syndrome. Other cardinal features of the syndrome include tall stature, arachnodactyly, ectopic lentis, and thoracic aortic aneurysm and dissection. Most clinicians fail to correlate the systemic features with the oral features, leading to misdiagnosis or under-reported. Marfan Syndrome requires thorough understanding of the genetic components that directly result in systemic manifestations, eventually leading to skeletal malocclusion, is crucial in managing the syndrome. A multidisciplinary approach is required to assess the condition before planning and implementing appropriate treatment protocols. In the present case report, authors presented a diagnosed case of Marfan syndrome. An 18-year-old female visited the Outpatient Department (OPD) of Oral Medicine and Radiology at a Tertiary Care Centre in Siliguri, West Bengal, India, seeking management for her skeletal malocclusion. After a thorough intraoral and extraoral examination, as well as smile assessment, orthognathic surgery was performed for preliminary tooth alignment using fixed appliances. The patient's healing process was uneventful, and she is currently being followed-up without any evidence of relapse. Early diagnosis, intervention, and judicious treatment planning with a multidisciplinary approach are key to achieving long-term stable results in correcting skeletal malocclusions associated with Marfan syndrome.

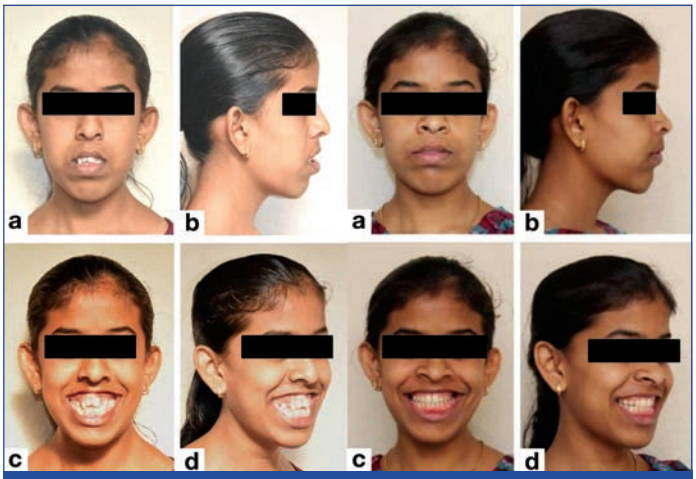
Keywords: Malocclusion, Orthodontic correction, Orthognathic surgery, Skeletal deformity

CASE REPORT

An 18-year-old female patient presented to the OPD of a Tertiary Care Centre with a chief complaint of improper tooth alignment and inability to close her mouth. The patient had a positive history of being diagnosed with Marfan syndrome and mild mitral valve tip prolapse. She was taking beta-blockers for her cardiac condition and occasionally experienced dyspnoea with slight exertion. Her cardiologist closely monitored her condition. During the patient's family history assessment, it was found that she had two perfectly normal siblings who were five and three years older than her, respectively. Neither her paternal nor maternal family members had any history of similar conditions. The patient had a stout build and good nutritional status. Apart from mild pallor, there was no evidence of anaemia, cyanosis, clubbing, jaundice, or oedema.

In terms of facial features, the patient had a convex profile with posterior divergence, an obtuse nasolabial angle, and a shallow mentolabial sulcus. The Frankfort Mandibular Plane Angle (FMPA) was clinically evaluated at 220, indicating that the patient was a horizontal grower with a hypodivergent growth pattern. She had a positive lip step with an everted, incompetent, and protruded lower lip. Her face was dolichocephalic with a hyperleptoproscopic facial index. The patient's skeletal midline was shifted to the right by 2 mm, with a philtrum height of 13 mm and commissure height of 24 mm. During smile assessment, it was observed that there was a 4 mm incisor exposure at rest and full crown exposure with 8 mm gingival exposure during smiling. The patient had a decreased buccal corridor and a flat smile arc [Table/Fig-1].

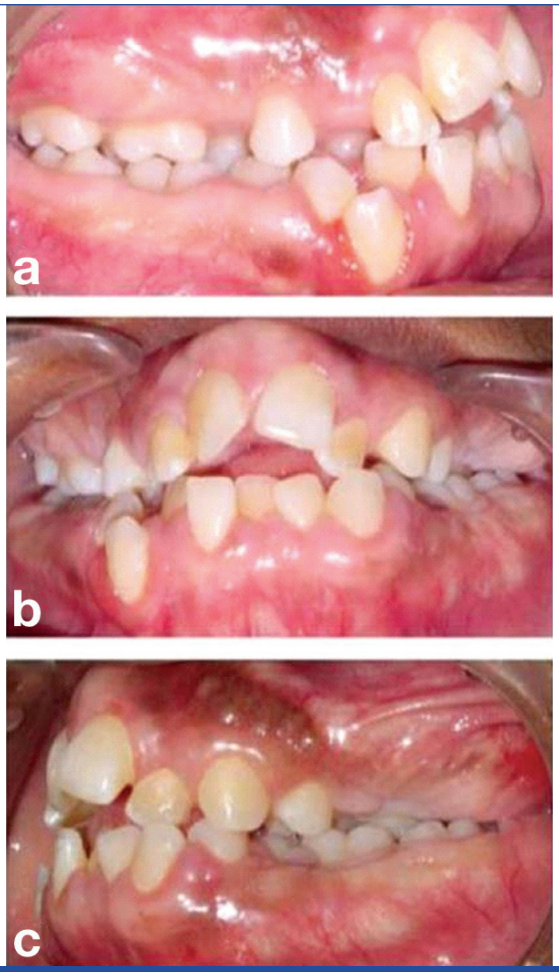
An end-on molar and canine relation was observed on the right-side, while a class III molar and canine relation was observed on the left-side. The patient had a 4 mm anterior open bite, 5 mm overjet, and enlarged adenoids. There was a positive history of tongue thrusting and mouth breathing habits. The upper midline was shifted to the right in relation to the skeletal midline, and the lower midline was shifted to the left in relation to the upper midline. The



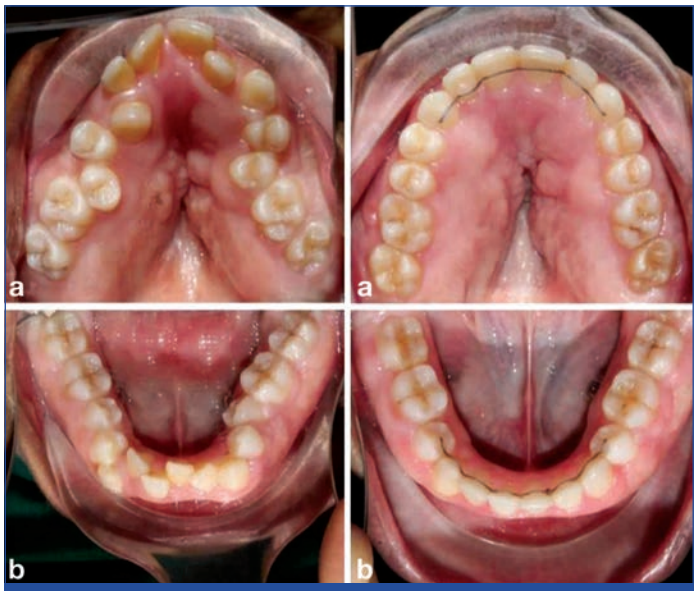
[Table/Fig-1]: Pretreatment facial and profile pictures of the patient (left a,b,c,d) and the post-treatment facial and profile pictures of the patient (right a,b,c,d).

patient also had a V-shaped maxillary arch and a square-shaped mandibular arch with a high palatal contour. Severe crowding was present in the upper and lower anterior teeth. Additionally, tooth 15 was rotated, and there was excessive palatal soft tissue and cross-bite involving teeth 15, 22, 24, 25, 26, 27, 33, 34, 35, 36, 37, and 45 [Table/Fig-2,3]. The clinical diagnosis was Angle's class III malocclusion with proclined upper anterior teeth, lower anterior crowding, anterior open bite on a skeletal class III base with a hypodivergent growth pattern, anteriorly divergent maxilla and mandible, and habits of tongue thrusting and mouth breathing with incompetent, hypotonic lips.

Preoperative assessment of the airway was conducted using the Malampatti classification, neck mobility, and upper lip bite test [1]. The initial examination revealed a restricted airway. Preoperative radiographic investigations, like Orthopantomogram (OPG) and lateral cephalogram, confirmed the preliminary diagnosis of a



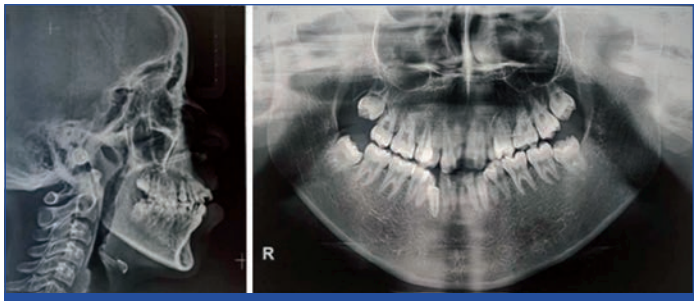
[Table/Fig-2]: Pretreatment right occlusal view (a), front view (b) and the left occlusal view (c).



[Table/Fig-3]: Pretreatment occlusal maxillary and mandibular views (left a and b) and the post-treatment occlusal maxillary and mandibular views (right a and b).

restricted airway [Table/Fig-4]. The pre- and post-treatment cephalometric values are listed in [Table/Fig-5-7]. The treatment objectives included correcting the proclined upper anterior teeth, lower anterior crowding, and anterior open bite, as well as correcting the cross bite. Additionally, the goal was to establish a patent airway, achieve a stable and harmonious soft tissue profile, and achieve functional occlusion with normal overjet and overbite. Prophylactic antibiotics were administered prior to tooth banding to reduce the risks of bacteraemia and subsequent endocarditis.

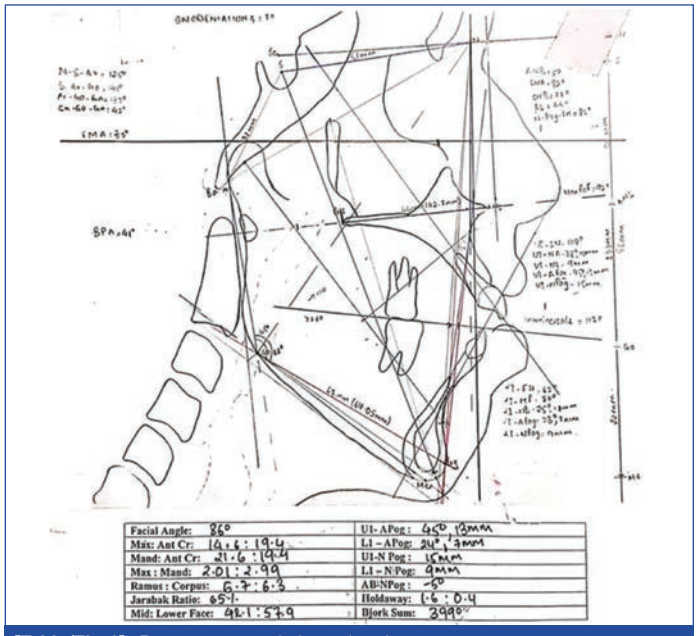
The stage I of treatment aimed at presurgical leveling and aligning. Orthodontic treatment began with the extraction of first premolars in



[Table/Fig-4]: Pretreatment Lateral Cephalogram (left) and the pretreatment Orthopantomogram (OPG) (right).

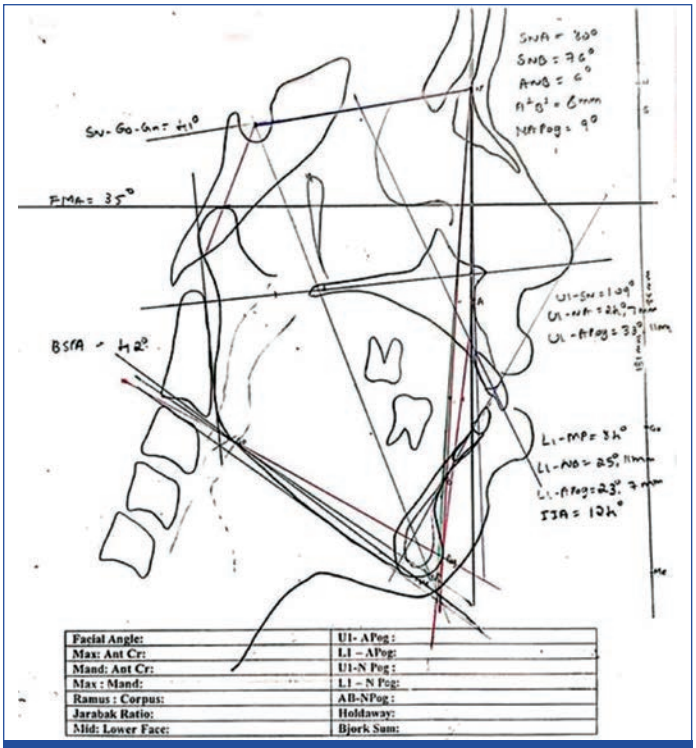
S. No.	Parameters	Pretreatment values	Post-treatment values
1.	SNA (°)	82	80
2.	SNB (°)	77	76
3.	ANB (°)	5	6
4.	Yaxis (°)	68	68
5.	Witts' appraisal (mm)	3	4
6.	Go GnSN (°)	42	41
7.	Go Me-FH (°)	35	35
8.	Posterior cranial base (mm)	37	37
9.	GoPog (mm)	67	67
10.	U1NA (°)	38	24
11.	L1NB (°)	25	23
12.	Interincisal angle (°)	112	124
13.	Nasolabial angle (°)	102	103
14.	Lower Lip to E plane (mm)	6	5
15.	Basal plane angle (°)	41	42
16.	UI-SN (°)	119	109
17.	LI-MP (°)	84	83
18.	NA-Pog (°)	7	9

[Table/Fig-5]: Pretreatment (left) and post-treatment (right) values obtained in the respective cephalograms.
SNA: Sella-nasion-A point; SNB: Sella-nasion-B point; ANB: ANB angle; WITS: Wits appraisal; Go: Gonial angle; Gn: Nathion angle; Pog: Pogonion; FH: Frankfurt horizontal plane; Saddle: Saddle angle; Facial: Facial angle



[Table/Fig-6]: Pretreatment cephalometric values.

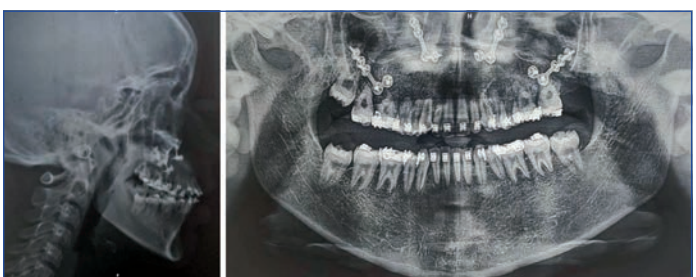
the mandibular arch. Fixed appliance treatment was initiated using a 0.022"×0.028" MBT prescription. Initial aligning and leveling involved the use of a 0.014" Stainless Steel (SS) wire with bite blocks, followed by a 0.014" SS wire and a 0.018" SS wire in both the upper and lower arches. Extraction space closure was achieved using friction



[Table/Fig-7]: Post-treatment cephalometric values.

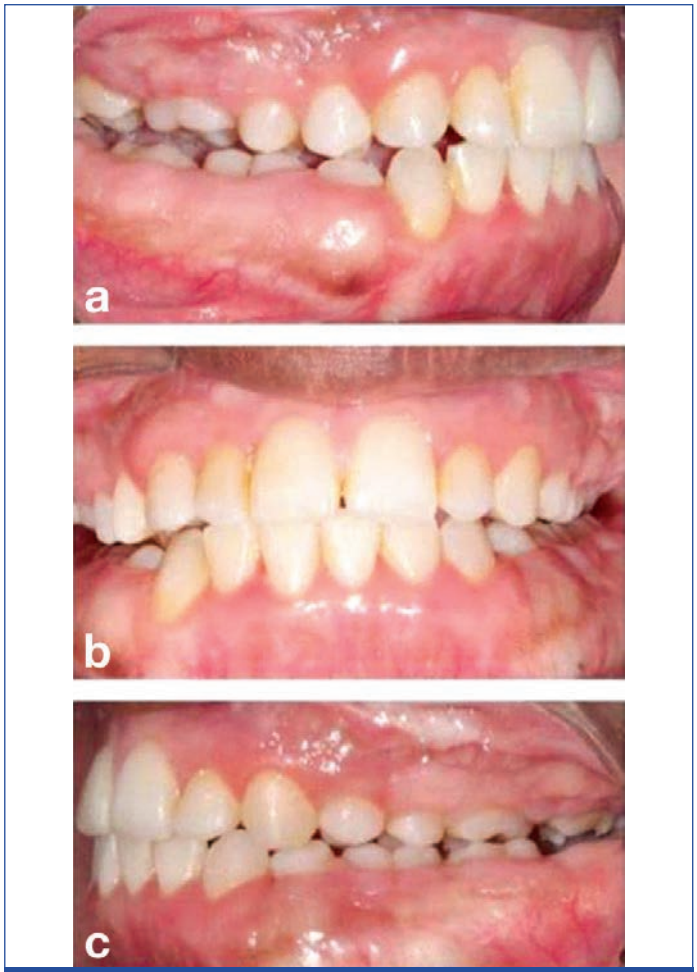
mechanics on a 0.019"×0.025" SS wire, with the second molar bonded. This was followed by the use of a 0.019"×0.025" SS wire with buccal root torque in tooth 14. The total treatment duration was approximately 15 months. These interventions resulted in improvement in the inclination of the upper anterior teeth, relief of crowding in the lower arch, correction of proclination and crowding of the upper incisors, and decrowding, uprighting, and retracting of the lower incisors by utilising the space created by the molar extraction, thus increasing the overjet.

The surgical phase, stage II of treatment, primarily aimed at correcting the skeletal anomalies. Prior to the surgery, a 0.019"×0.025" SS wire was placed in the upper arch and a 0.018" SS wire was placed in the lower arch. Orthognathic surgery was performed, resulting in a 6 mm mandibular setback, 4 mm maxillary setback, and 3 mm maxillary impaction. Immediately after the surgery, a temporary plate was placed, which was later removed for radiography. The 0.019"×0.025" SS wire in the upper arch and 0.018" SS wire in the lower arch were left in place for four weeks postsurgery. The patient's postoperative recovery was uneventful. Postoperative OPG and lateral cephalogram were taken to assess the skeletal outcome and revealed an improved airway in the patient [Table/Fig-8].



[Table/Fig-8]: Post-treatment lateral cephalogram (left) and the post-treatment Orthopantomogram (OPG) (right).

The finishing and settling phase began one month after the surgery, using a 0.018" SS wire and settling elastics in both the upper and lower arches. The total duration of the settling and finishing phase was six weeks, with periodic follow-ups at two weeks interval. Once functional, stable, and aesthetic occlusion was achieved [Table/Fig-3,9], the wires were removed, and the patient underwent rigid bi-weekly follow-ups for a total duration of 12 months. No relapses have been identified thus far.



[Table/Fig-9]: Post-treatment right occlusal view (right A), front view (right B) and the left occlusal view (right C).

DISCUSSION

The National Marfan Foundation describes Marfan syndrome as an inheritable disorder of connective tissue that affects the heart, blood vessels, lungs, eyes, bones, and ligaments [2]. The majority of mutations in the FBN1 gene are missense mutations, where a single nucleotide change results in the substitution of one amino acid for another in the FBN1 protein sequence. These mutations often disrupt the structure and function of fibrillin-1, leading to the characteristic features of Marfan syndrome [3]. The worldwide incidence of Marfan syndrome is 7-17/100,000 [4]. With the lack of specific laboratory tools, the main method of identification relies on the Ghent criteria, which delineate major and minor diagnostic features of the syndrome [5]. The characteristic features of Marfan syndrome include serious cardiovascular complications with varying degrees of manifestation. While in the case report by Jain E and Pandey RK found patent ductus arteriosus and Ganesh R et al., revealed the presence of tricuspid and mitral valve prolapse with aortic dilatation [4,6]. Mitral valve tip prolapse was present in the present case report. Stengl R et al., and Price-Kuehne F et al., both reported aortic insufficiency in Marfan syndrome patients secondary to aneurysms and root dilatation, respectively [7,8].

Pathognomonic ocular anomalies in Marfan syndrome include myopia and ectopic lentis, cataracts and retinal detachment, and rarely dislocation of the lens [4,7,9]. In the present case report, no serious ocular complications were present. Other systemic manifestations among syndromic patients include musculoskeletal anomalies like joint laxity and hypermobility, skeletal anomalies like tall stature, long slender build with long arms, legs, and fingers, and a greater than normal wingspan. Respiratory complications like pneumothorax and obstructive sleep apnoea, and rarely neurological manifestations like dural ectasia, can also occur [5]. Among the relatively uncommon systemic manifestations, Jain E and Pandey

S. No.	Authors	Age/sex	Skeletal malocclusion	Ophthalmic conditions	Cardiac conditions	Other systemic conditions
1	Ganesh R et al., [6]	6/F	Angle's class I mal-occlusion with crowding in lower anteriors.	No anomalies reported.	Tricuspid and mitral valve prolapse and dilation of aorta.	Arachnodactyly.
2	Chemma T et al., [12]	28/M	Angle's class I mal-occlusion.	No anomalies reported.	Status post aortic root and total arch replacement and descending aortic dissection repair with mechanical aortic valve replacement due to regurgitation.	No anomalies reported.
3	Jain E and Pandey RK [4]	13/F	Angle's class II molar relation with anterior and posterior cross-bite and high arched palate.	No anomalies reported.	Patent ductus arteriosus, closed surgically at six years.	Brachial arch syndrome, malformation of the right sternocleidomastoid.
4	Stengl R et al., [7]	41/M	Angle's class I mal-occlusion with high arched palate and crowding.	Ectopic lentis and myopia.	Aortic insufficiency with frequent episodes of aneurysms.	Dyspnoea on slight exertion.
5	Price-Kuehne F et al., [8]	10/F	Angle's class I mal-occlusion.	No anomalies reported.	Aortic root dilatation.	Systemic vasculitis, unusual skin rash.
6	Naidoo P et al., [9]	18/M	Angle's class II mal-occlusion with anterior openbite and crowding.	Left dense cataract with lens subluxation but no dislocation, iridodonesis, an old retinal detachment and minimal light perception. The right eye had showed iridodonesis with myopia.	Prolapse of the anterior mitral valve leaflet with moderately severe mitral regurgitation and aortic root dilatation.	Arachnodactyly, pectus carinatum deformity, hind foot valgus, increased arm span/height, scoliosis, downslanting palpebral fissures and malar hypoplasia.

[Table/Fig-10]: Various clinical manifestations of the previously reported cases of Marfan syndrome [4,6-9,12].

RK reported branchial arch syndrome, while Price-Kuehne F et al., reported systemic vasculitis, and Naidoo P et al., reported arachnodactyly, pectus carinatum deformity, hind foot valgus, scoliosis, down-slanting palpebral fissures, and malar hypoplasia [4,8,9]. In the present case report, arachnodactyly was present.

Skeletal malocclusions in Marfan syndrome can have significant functional and psychosocial implications. Skeletal malocclusion is known to affect biting and chewing efficiency, leading to difficulties in food consumption and eventually digestion. Speech may also be affected due to improper alignment of the teeth and jaws. Additionally, the visible impact of skeletal malocclusions on facial aesthetics can have a negative impact on an individual's self-esteem and overall quality of life [5,10]. Almost all of the Marfan syndrome patients reported by Ganesh R et al., Stengl R et al., Price-Kuehne F et al., Jain E and Pandey RK, and Naidoo P et al., were associated with some form of skeletal malocclusion ranging from Angle's class I to class II with subdivisions [4,6-9]. This indicates that skeletal malocclusion is one of the most common and diagnostic features among Marfan syndrome patients, highlighting the role of dentists in the early diagnosis and intervention. The management of skeletal malocclusions in syndromic patients often requires a multidisciplinary approach, involving collaboration between orthodontists and other medical professionals. Close coordination with cardiologists and ophthalmologists is crucial to ensure the overall health and well-being of the patients [3].

The index patient had already been diagnosed with Marfan syndrome when she reported to the OPD and was undergoing extensive treatment for her systemic conditions. No major challenges were faced during her treatment and/or surgical phase. Her cardiologist was consulted before commencing the surgery, and the entire treatment was done in collaboration with her treating cardiologist, general physician, and ophthalmologist. The patient presented at 18 years of age, allowing for early initiation of treatment. Early diagnosis and treatment planning played a pivotal role in avoiding severe skeletal symptoms that could have developed later in her life [6-9]. Before planning orthognathic surgery, her dental crowding was aligned with fixed appliances. The goal of treatment was to improve dental alignment, optimise functional occlusion, and enhance facial aesthetics. The desired results could be achieved with the proposed treatment plan, and the patient is currently under strict follow-up without any evidence of relapse.

This is the first reported case of Marfan syndrome where the orthodontic management of skeletal malocclusion has been discussed in detail. The present case report can serve as a guide on how to clinically assess skeletal malocclusion and provide management using an interdisciplinary approach. Future directions would be to understand the underlying mechanisms of skeletal malocclusions in Marfan syndrome and develop targeted therapies to address these specific dental challenges [11]. None of the previously reported cases of Marfan syndrome discuss the management of skeletal malocclusion and the challenges encountered [Table/Fig-10] [4,6-9,12].

CONCLUSION(S)

Patients with Marfan syndrome can undergo orthodontic treatment, just like their healthy counterparts. Surgical procedures can be undertaken with appropriate precautions and a multidisciplinary approach. The presence of cardiac and systemic conditions, along with skeletal malocclusion and a prior diagnosis, makes the present case unique and likely the first of its kind where the complete orthodontic treatment, including the surgical part, has been described in detail. Early diagnosis and proper treatment planning remain imperative for the long-term success of treatment and stable results.

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