

CURVE OF SPEE IN ORTHODONTICS: A REVIEW ARTICLE

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ABSTRACT

The presence of a curve of Spee (COS) of variable depth is a common finding in the occlusal arrangement and is the sixth key of occlusion. The understanding of COS in the field of orthodontics is very important as orthodontists deal with it in virtually every patient they treat. An excessive COS is a common form of malocclusion that may be addressed in many ways, including posterior extrusion, anterior intrusion, and incisor proclination. The specific approach to leveling of COS should be selected based on each patient's needs. Soft tissue, crown-gingival relations, occlusal plane, and skeletofacial concerns are among the special considerations for treatment planning for leveling of COS.

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Introduction

Curve of Spee is a naturally occurring phenomenon in the human dentition. This normal occlusal curvature is required for an efficient masticatory system. Orthodontists eventually deal with the curve of Spee in virtually every patient they treat. The aim of this review is to increase our knowledge regarding the development and effects of a curve of Spee on dentition and its treatment in exaggerated cases. It would be useful if we have a thorough knowledge of how and when this curve of Spee develops, so that it will help the orthodontists during the treatment of their cases.

A profile view of human skull reveals an upward, concave curve in the mandibular teeth extending from molars to incisors and corresponding downward, convex curve in the maxillary arch. These peculiarities of the geometric arrangement of the teeth were first described by Ferdinand Graf Von Spee¹ in 1890, using 120 skulls with abraded teeth to define a line of occlusion, to lie on a cylinder which is tangent to the anterior border of the condyle, the occlusal surfaces of second molar and incisal edges of the mandibular incisors and has since been referred to as 'The curve of Spee'. It has been suggested that the curve of Spee has a biomechanical function during food processing by increasing the crush shear ratio between the posterior teeth and the efficiency of the occlusal forces during mastication².

Andrews LF considered flat to slight curve of Spee to be one of the six characteristics of normal occlusion. He also stated that, there was a natural tendency for the curve to deepen with time because the lower jaw sometimes grows faster and continues for longer period

than that of the upper jaw³. This causes the lower anterior teeth, which are confined by the upper anterior teeth and lips, to be forced backward and upward, resulting in deeper overbite and a deeper curve of Spee. So, the treatment objective should be to achieve a flat curve as an over treatment.

According to the glossary of Prosthodontic terms, 1994 COS⁴, was defined as the anatomical curve established by the occlusal alignment of the teeth, as projected onto the median plane, beginning with the cusp tip of the mandibular canine and following the buccal cusp tips of the premolar and molar teeth, continuing through the anterior border of the mandibular ramus and ending at the anterior aspect of the mandibular condyle.

Development Of Curve Of Spee

Factors affecting the development of curve of Spee.⁵

Dental factors-

Overall, the development of the COS is likely due to a combination of factors, including dental eruption timing, craniofacial variation, and neuromuscular factors. Perhaps the mandibular molars and incisors are permitted to erupt beyond the original occlusal plane due to the fact that they erupt earlier than their maxillary antagonist and are, therefore, unopposed.

Dentition stage

The occlusal plane is flat in the complete deciduous dentition. During the transition into mixed dentition, increases largely with the eruption of the central incisors and first permanent molars, and finally reaches a maximum with the eruption of the stable throughout adolescence and into adulthood⁶.

Malocclusion

Curve of Spee is the most severe in Class II division 2 subjects, followed by Class II division 1 subjects, then Class I subjects, with the least amount of depth is detected in Class III subject⁷.

Facial pattern

In humans, an increased COS is often seen in brachycephalic facial patterns and associated with short mandibular bodies⁸.

Properties Of Curve Of Spee

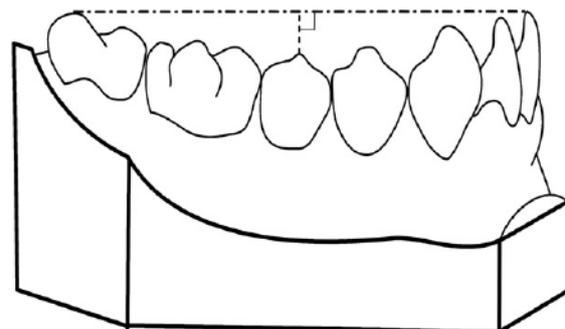
The curve of Spee is correlated with overjet and overbite. COS is directly proportional to overjet and overbite of an individual. By increasing overjet and overbite, it will deeper COS⁹. COS is described as deepest in class II, while it is flatter and with insignificant variances in class I and class III subjects.

It was established that the depth of the COS is greatest in the Class II, Division 1, followed by Class II, Division 2, Class I, and Class III. However, there is no significant difference between Class II division 1 or 2¹⁰.

Measurement Of Curve Of Spee

Typically the curve of Spee has been measured outside of the patient's mouth using one of two methods: orthodontic study models, and/or lateral cephalometric images A more simplified and common clinical method of quickly evaluating the curve of Spee using study models is to lay the mandibular cast upside-down on a

flat surface such that the model would be tripodded on the most extruded molar cusps on the right and left sides posteriorly and the most extruded incisor tip anteriorly (Braun et al, 1996). From here, the depth of the curve can then merely ranked in severity (mild/moderate/severe) or precisely measured¹¹.



Evaluation of the curve of Spee has also taken place with the use of lateral cephalometric radiographs. The same principles apply, where some form of a curve of Spee line joining a molar cusp and incisor tip is used as a reference plane and the distance to the most intruded premolar is measured either by a ruler on a plain film, or by a computer software program on a digital film (Bernstein et al, 2007)⁶.

According to Baldrige¹², the sum of the distances from all teeth in a quadrant to the occlusal plane (right and left sides have separate measurements).

Sondhi et al¹³ says that COS is the sum of the perpendicular distances from cusp tips of canine, premolars, and mesiobuccal cusp tip of the first molar to the occlusal plane (line connecting distobuccal cusp of the first molar and incisor) from the right side only.



Bishara et al¹⁴ also determined COS as the average of the sum of the perpendicular distances from cusp tips of the canine, premolars and mesiobuccal cusp of the first molar to a reference line drawn from the incisal edge of the central incisor to the distal cusp tip of the second molar.

Leveling Curve Of Spee

It is suggested that leveling and flattening curve of Spee should be treatment objective in orthodontic treatment to obtain proper biomechanical function during food processing by increasing the crush/shear ratio between posterior teeth and the efficiency of occlusal forces during mastication¹².

The exaggerated curve of Spee may alter muscle balance, ultimately leading to the improper functional occlusion and the presence of COS may make it possible for a dentition to resist the forces of occlusion during mastication¹⁵.

Deep COS makes it almost impossible to achieve class I canine relationship, it may also result in occlusal interferences that will manifest during mandibular function.

Methods of leveling curve of Spee

Different orthodontic methods have been used for years to level the COS.

Exaggerated COS can be corrected by following methods¹⁵.

- Extrusion of molars
- Intrusion of incisors

- Combination of both the movements
- Proclination of incisors

Extrusion of molars

- Continuous archwires or segmented archwires
- Reverse COS and/or maxillary exaggerated COS wires
- Step bends
- Anterior bite plate
- Altering bracket placement heights.

One millimeter of upper or lower molar extrusion effectively reduces the incisor overlap by 1.5–2.5 mm.

Indications

- Patients with short lower facial height
- Excessive COS
- Moderate-to-minimal incisor display.

Disadvantages

- Stability is questionable in nongrowing patients
- Excessive incisor display
- Increase in the interlabial gap and worsening of gingival smile.

Intrusion of incisors

Intrusion of upper and/or lower incisors is a desirable method to level COS in many adolescent and adult patients^{16,17}.

The four most common methods:

- Burstone
- Begg and Kesling
- Ricketts
- Greig.

All four designs apply tipback bends at the molars to provide an intrusive force at the incisors. Utility arches



are arch wires that are bent in such a way that they bypass the buccal segment and are engaged on the incisors. These arches can be used to perform a number of tooth movements, including the intrusion of incisors, protraction or even retraction of incisors. They are activated by giving a V bend in the buccal segment of the wire so as to produce an intrusive force on the anteriors.

Recommended forces for intrusion of lower incisors are in the range of 12.5 g/tooth and for maxillary incisors about 15–20 g/tooth. The reactionary extrusive force on molars is prevented by natural interdigitating occlusion or in extreme cases by giving a posterior bite plane of minimum thickness.

Indications

- Patients with a large vertical dimension
- Excessive incision-stomion distance
- Large interlabial gap.

Disadvantage

External apical root resorption

Incisor proclination

Incisors proclination is another method for leveling the COS. Some researchers claim that COS is predominantly flattened by proclining lower incisors. For each 1 mm of leveling the mandibular incisors will be proclined 4° , without increasing arch width. In addition, it is suggested that 1mm of arch circumference is required to level 1 mm of COS. It is assumed that the amount needed is variable depending on the type of mechanics applied¹⁸.

Stability

Lie et al. investigated the post-treatment advancement of the curve of Spee and its post-treatment stability on the basis of cephalometric parameters and showed that more stability might be expected after relatively large leveling changes of deep curves during treatment, while there seems to be a tendency toward less stability and more spontaneous changes when treatment involves small changes¹⁹.

Relapse of the curve of Spee is usually associated with the deepening of the bite post-retention. The study stated that the correlation between relapse of the curve of Spee and that of the overjet and overbite was mild. The mechanism for relapse of overbite could be that the bite was deepened by the extrusion of the maxillary anterior dentition rather than the lower anterior dentition. As the curve of Spee in the present study was measured only in the mandible, this explains the stability of the measured curve of Spee²⁰. Buraiki et al, investigated stability of incisor intrusion, showed that intrusion of maxillary incisors to be a stable procedure²¹.

Retention

Corrected COS in either Class I or Class II malocclusions usually require retention in a vertical plane (moderate retention). If anterior teeth were depressed to achieve overbite correction, a bite plate on a maxillary retainer is desirable. It is worn continuously for perhaps the first 4–6 months. Often the incisal edges of the anterior teeth are unworn and require spot grinding and adjusting in some class II division I cases.



If cases of skeletal deep bite correction is achieved as a result of bite opening. In these cases the mandible is forced away from the maxilla and the vertical dimensions should be held until growth (i.e., mandibular ramal height) can catch up. The changes of the mandibular plane angle suggest proper retention

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