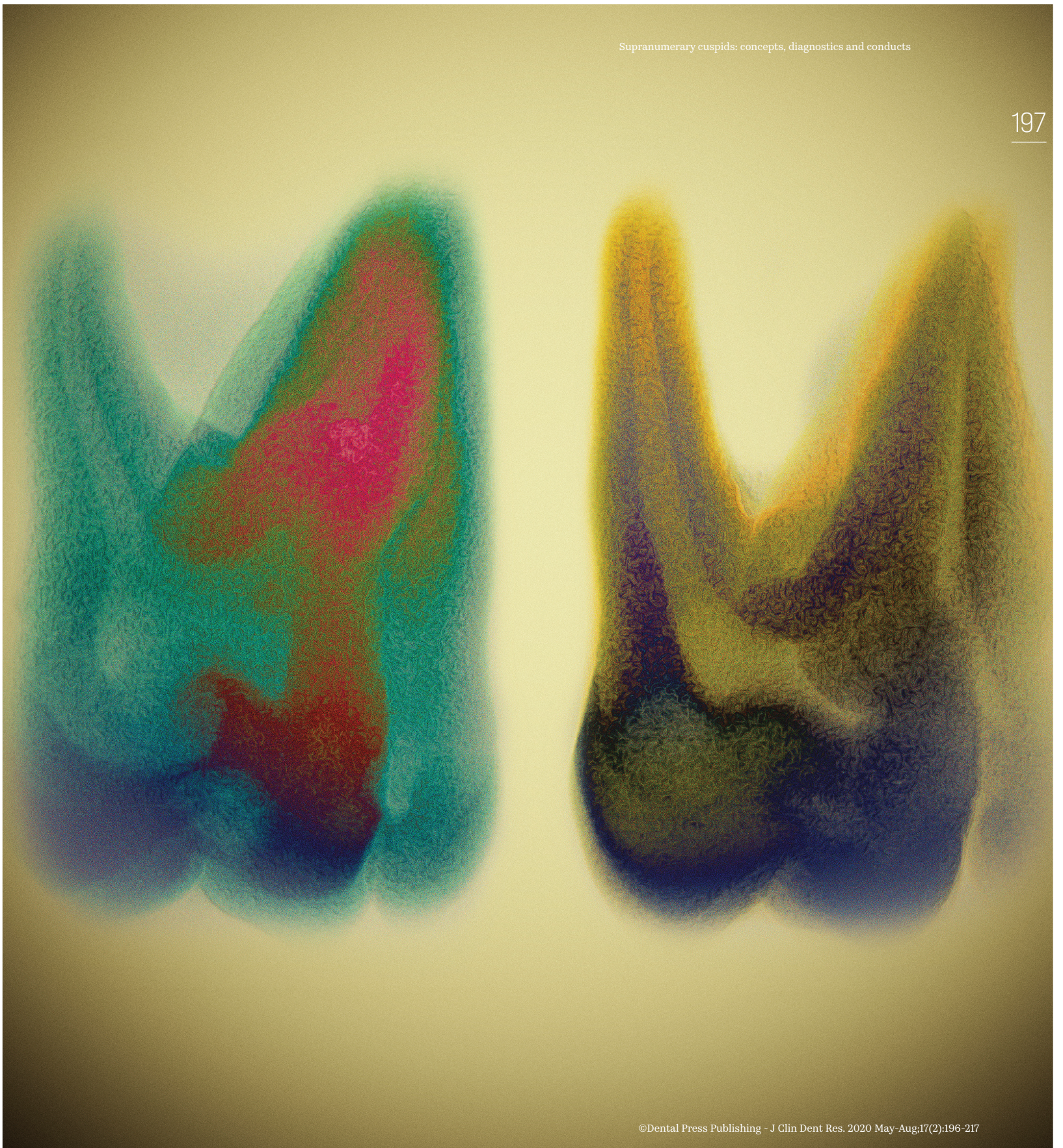


# Supranumerary cuspids: concepts, diagnostics and conducts

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## ABSTRACT

*Supernumerary cusps are rarely explored clinically or recorded. Lack of knowledge about them is why professionals and patients, in special, do not give them the importance that their correction and adaptation should receive. The presence of a supernumerary cusp should be disclosed to the patient, and its importance should be stressed. In special, attention should be drawn to the treatment required to manage and correct this anomaly, whether its consequences are esthetic or functional. The developmental tooth anomalies classified as supernumerary are: 1) Cusp of Carabelli; 2) Paramolar; 3) Tubercle of Traviani; 4) Tubercle of Zuckerkländl; 5) Dens evaginatus; 6) Talon cusp; 7) Prominent talon cusp; and 8) Molarized premolar.*

## Keywords:

*Supernumerary cusps. Tooth anomalies. Cusp of Carabelli. Paramolar. Tubercle of Traviani. Dens evaginatus. Talon cusp.*

## INTRODUCTION

Supernumerary cusps are often not diagnosed, nor included in patient records, unless exacerbated. They may affect aesthetics and occlusion; when they do not, they may complicate the placement of prosthetic, orthodontic or orthopedic appliances. They also have great importance in forensic dentistry<sup>2</sup>.

The supernumerary cusps are classified as:

1. *Cusp of Carabelli;*
2. *Paramolar;*
3. *Tubercle of Traviani;*
4. *Tubercle of Zuckerklantl;*
5. *Dens evaginatus, also called central accessory cusp;*
6. *Talon cusp;*
7. *Prominent talon cusp; and*
8. *Molarized premolar.*

## CUSP OF CARABELLI

Cusps of Carabelli are found in the mesiolingual cusp of permanent maxillary first molars (Fig. 1 and 2). They were first described in 1842 by Georg C. Carabelli, the dentist of the Austrian Court at the time (Fig. 3). Its size

ranges from a discrete enamel protuberance to a full cusp, and it might even have an internal pulp projection or horn. In some extreme cases, it has a root independent from the other roots of the first molar.



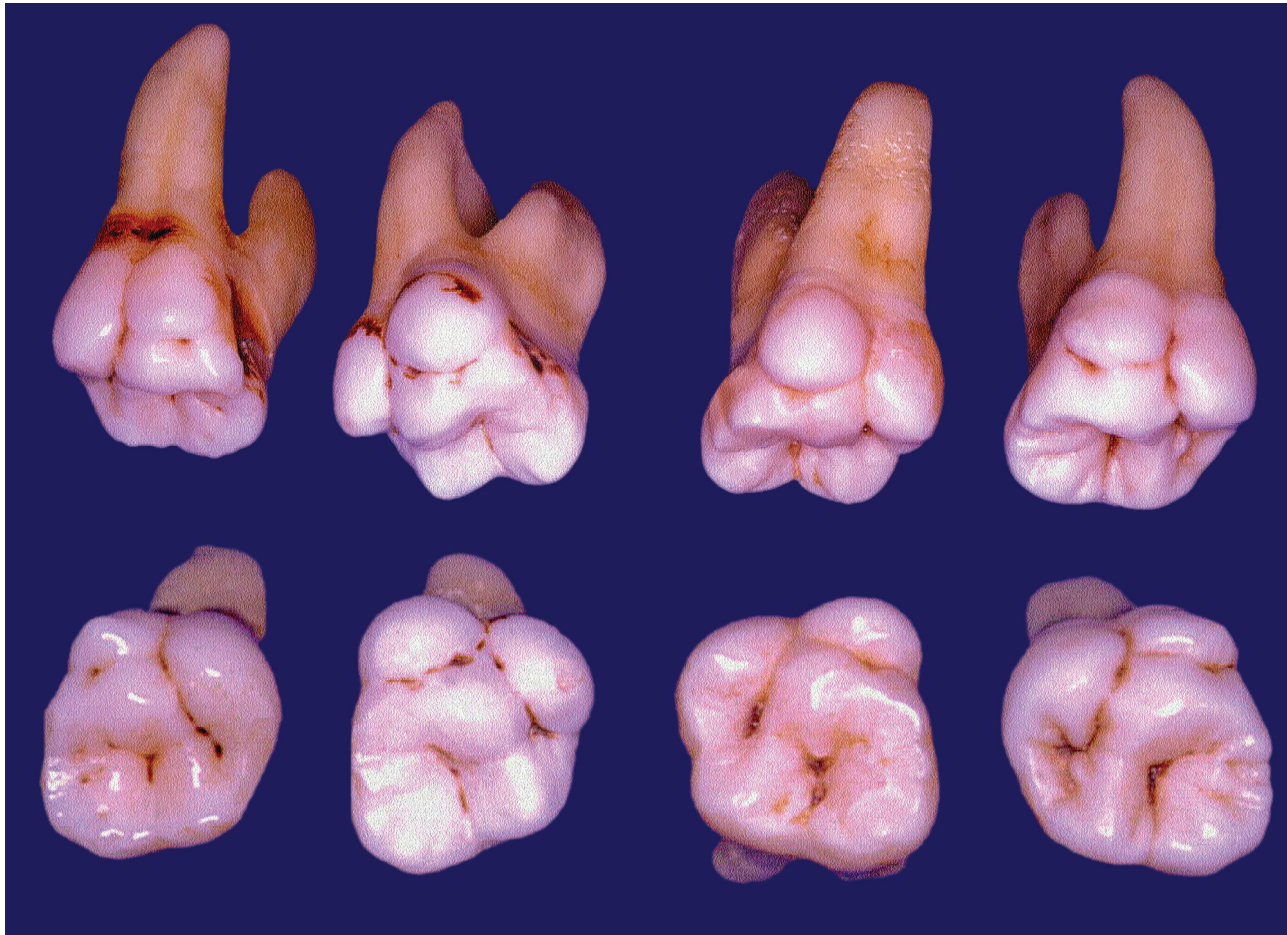


Figure 1: Cusps of Carabelli at variable degrees of volume and size, classified as type I, II and III.

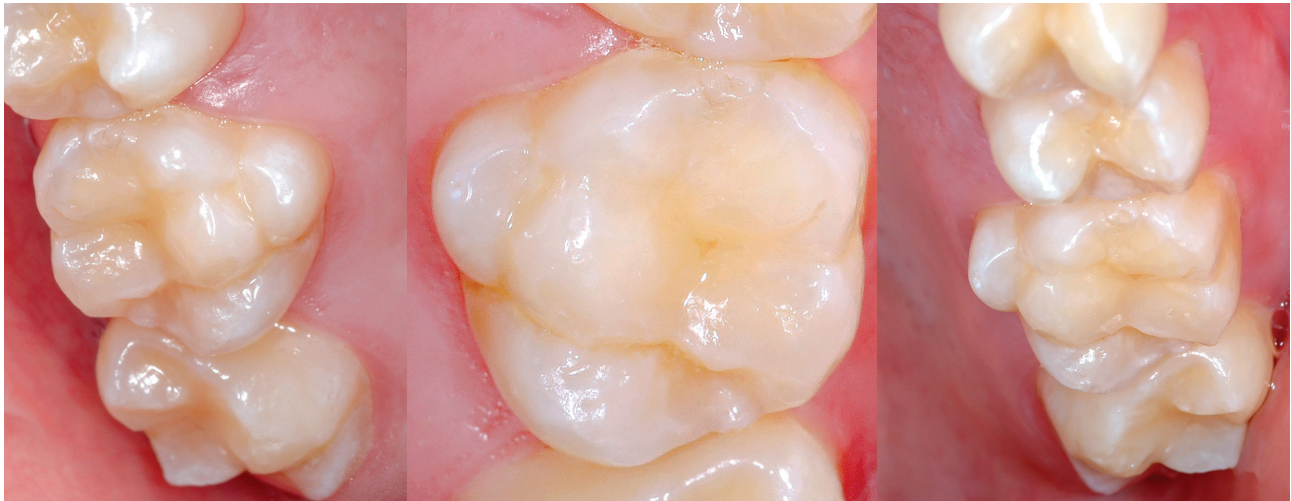


Figure 2: Bilateral cusps of Carabelli that participate in occlusion.



Figura 3: (A) Georg C. Carabelli, Hungarian dentist in the Austrian court and one of the founders of the stomatology clinic in Vienna University. Dutch anatomist Louis Bolck (B). They described tubercles in 1842 and 1916.



As it is extremely common in dental clinical routine, the term used to describe it and the way the patient is informed about it should be accurate. Therefore, we have classified the cusp of Carabelli in three types:

- I = Vestigial or rudimentary**, when the supernumerary cusp ranges from a discrete elevation and depression to a well-defined conical structure, which, however, does not reach the occlusal plane;
- II = Full or occlusal**, when the supernumerary cusp reaches the occlusal plane of the first molar, and its protuberance rises from the cementoenamel junction; and
- III = Cervical or radicular**, when the cusp of Carabelli forms a protuberance at the cementoenamel junction or on the lingual root, and when, very rarely, it has a fused or independent root.

The cusp of Carabelli is usually bilateral and may occur simultaneously in the second and third molars, although it is usually found in the maxillary first molar. In Brazil, cusps of Carabelli were found in 71% of men and in

50.5% of women<sup>3</sup>. Some researchers of dental morphology have even raised question of whether a cusp of Carabelli should be considered normal, because of its high incidence in the population, at a rate of up to 92%.<sup>4,5</sup>

### Causes and mechanisms

1. In some rare cases, cusps of Carabelli have a root that is partially or fully independent from the pulp of the tooth where it is found. In these cases, it is unclear whether it results from the fusion of a molar and a supernumerary conical tooth. However, this type of supernumerary conical tooth on the lingual surface of the permanent first premolar is extremely rare.
2. Cusps of Carabelli may hold an anthropological meaning not yet explained or fully demonstrated, as it is also found in the most ancient human fossils. In some cases, the cusp of Carabelli is described as an atavistic sign, indicating that contemporary generations have characteristics of our ancient ancestors.
3. The origin of the process that generates the cusp of Carabelli is genetic, as it invariably begins in the first phases of odontogenesis. The hereditary pattern that is probably involved in familial cases has not been fully explained.

### Treatment considerations

Endodontic interventions in a tooth with a cusp of Carabelli should take into consideration changes to its internal anatomy. Procedures for the placement of prosthetic, orthopedic or orthodontic appliances should be adapted to each case. If drilling is the option



chosen, the dentin and, in extreme cases, the pulp space itself should not be suddenly exposed to the oral environment. Drilling during treatment should be gradual and im-

mediately followed by the restoration of the tooth surface, as the anomaly is in an area that is in constant contact with the tongue.

### PARAMOLAR

Paramolars are characterized by a supernumerary cusp on the buccal surface of the maxillary second and third molars. They were first described by the Dutch anatomist Louis Bolk in 1916<sup>6</sup>. Although this type of tubercle is closely associated with the mesio-buccal cusp of molars, it may, in some rare

occasions, be found on the buccal surface of maxillary premolars<sup>7</sup> (Fig. 4, 5 and 6). Its size ranges from a discrete enamel protuberance to a full cusp, and it might even have an internal pulp projection or horn (Fig. 4, 5 and 6). It may be bilateral, and it is much less frequent than the cusp of Carabelli.



Figure 4: Paramolars (Bolk) in maxillary third molar, maxillary premolar and maxillary second molars.

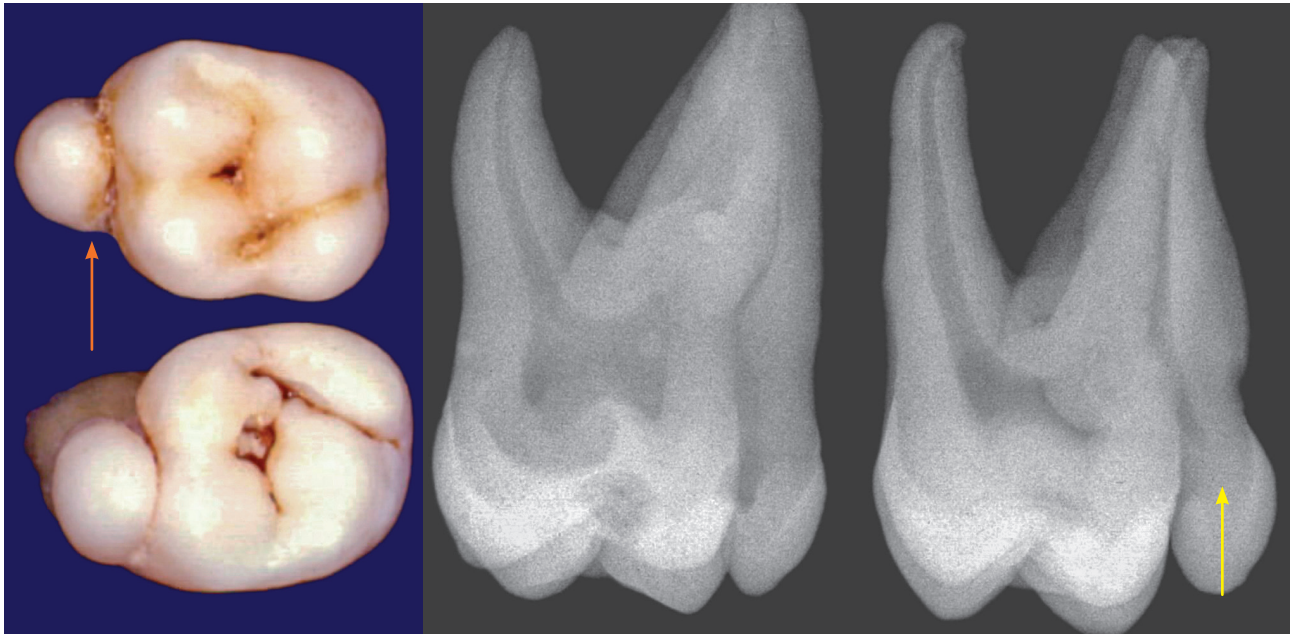


Figure 5: Paramolar may have an independent canal or root (arrows).

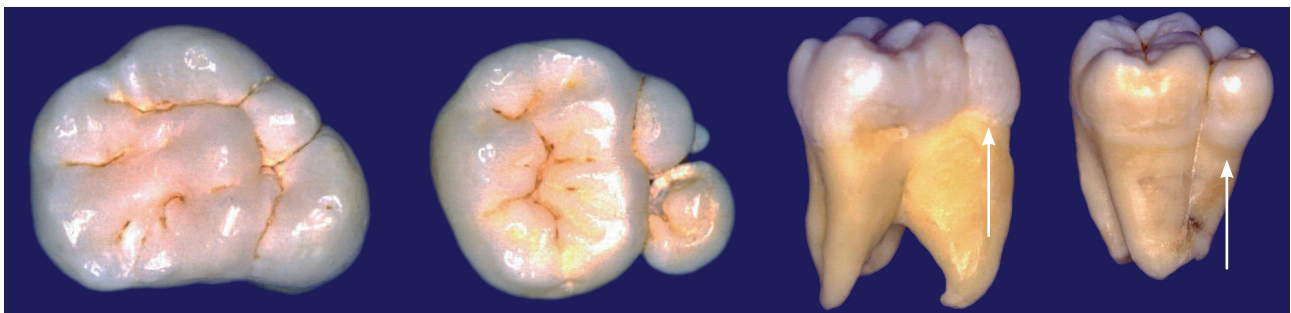


Figure 6: Paramolar may be the result of fusion with supernumerary tooth, especially when it has an independent canal or root (arrows).



### Causes and mechanisms

1. Some rare cases of paramolars have a partial or full root independent from the tooth where it is found (Fig. 6). These cases may result from a fusion of the molar with a conical supernumerary tooth. That is, a fourth tooth, also called a fourth molar, the paramolar, is sometimes found in this region. This supports the coherence of this theory in explaining these cases of paramolars with an independent root and pulp.
2. The paramolar, similarly to the cusp of Carabelli, may hold an anthropological meaning not yet explained or fully demonstrated, as it is also found in the most ancient human fossils.
3. Paramolars are formed bilaterally in the beginning of odontogenesis. This indicates that a genetic component is involved in their development, which may hold an anthropological value yet to be determined. The hereditary pattern of some familial cases have not been properly determined.

### Treatment considerations

As it is found on the buccal surface, paramolars may affect esthetics, particularly when associated with premolars (Fig. 4). Corrective drilling, if adopted, should be gradual, particularly if it may result in dentin exposure. The use of veneers or minimal thickness veneers should be evaluated, as it may be more convenient in these cases.

Endodontic interventions in a tooth associated with a paramolar should take into consideration changes to its internal anatomy.

The placement of prosthetic, orthopedic or orthodontic appliances should follow individualized procedures when treating these teeth. If drilling is the option chosen, the dentin and, in extreme cases, the pulp space

itself must not be exposed to the oral environment. In addition, in case of gradual drilling, a smooth tooth surface should be created to avoid irritation of the buccal mucosa, as the buccal surface is in constant contact with it.

### TUBERCLE OF TRAVIANI

The tubercle of Traviani, a supernumerary cusp on the distolingual cusp of maxillary molars, has received very little attention in studies. It is often classified as a cusp of Carabelli, but this cusp is found on the mesiolingual cusp of maxillary cusps. A supernumer-

ary cusp on the distolingual cusp of molars should be referred to as a tubercle of Traviani.

The causes, mechanism and treatment procedures should be exactly the same as those applied to cusps of Carabelli and paramolars.

### TUBERCLE OF ZUCKERKLANDL

Tubercles of Zuckerkländl, which affect only primary teeth, are found on the mesiobuccal cusp of primary first molars in either dental arch. Their location is exactly over the mesial root, just above the cemento-enamel junction, practically forming an eminence. They affect individuals regardless of their age or

ethnicity. They practically make part of the crown anatomy of the primary mandibular first molar and do not require any treatment or special care.



## DENS EVAGINATUS

This anomaly is also known as a central accessory cusp, because it is found in the center of the occlusal surface of mandibular premolars, usually affecting occlusion<sup>8</sup>. They are rarely found in molars and or canines (Fig. 7). Other names are used for a dens evagi-

natus, in addition to central accessory cusp: occlusal tubercle, occlusal enamel pearl and Leong's premolar. A dens evaginatus in anterior teeth occurs as a talon cusp and, according to several authors, corresponds to the same disease.

The name dens evaginatus was assigned to it in a conceptual contrast with the disorder known as dens invaginatus, or dens in dente, in which there is invagination of the enamel organ epithelium towards the dental papilla. This epithelial invagination turns into ameloblasts and produces enamel, and appears on images as a tooth within another tooth.



**Figure 7:** Dens evaginatus, also called central accessory cusp, has a pulp projection (arrows), and dentin and enamel that require special attention during treatment.

### Mechanism and cause

1. In a dens evaginatus, in contrast with a dens invaginatus, the enamel organ epithelium invades or moves into the stellate reticulum and the external epithelium, projecting onto pericoronal follicular tissues. It is differentiated from ameloblasts and forms enamel that projects outwards, as a horn, dome or sphere. Therefore, it also receives the name of central accessory cusp;
2. Its mechanism is necessarily genetically determined, but the genes responsible for it and their biological meaning remain unclear. If there is a familial pattern to which this developmental disorder should be assigned, it has not been determined yet by studies about genetic inheritance; and
3. As it is bilateral and multiple in some cases, dens evaginatus was initially described as a characteristic of Asian people,<sup>9,10</sup> but today we know that it affects all ethnic groups.

### Treatment considerations

Treatment should:

1. Preserve pulp vitality;
2. Meet aesthetic and occlusal requirements;
3. Prevent caries by sealing or eradicating grooves; and
4. Eliminate tongue irritation by making the surface smooth.<sup>9,10</sup>

The central accessory cusp, or dens evaginatus, has a greatly variable proportion, but natural

attrition, the action of a drilling instrument, or both, when applied gradually, expose the dentin and, in some cases, the pulp space as well, because the cusp has an internal pulp projection or a pulp horn (Fig. 7). When very delicate, it may fracture and expose the pulp projection that it contains, inducing pulpitis and necrosis.

If deeper drilling is necessary on the occlusal surface, the tooth should be treated endodontically.

In case its roots are not fully formed, the tooth may be removed from occlusion for three to four months, and selective drilling performed until reactionary dentin is formed at the pulp limits. After that, the conventional restorative procedure should be adopted.

### TALON CUSP

A talon cusp, called by this name because of the symbolic similarity of this anomaly with the talons of a bird (Fig 8 and 9), has a predilection for incisors, especially maxillary lateral incisors,<sup>11,12</sup> including supernumerary and primary teeth. Talon cusps may be classified as a form of dens evaginatus that affects anterior teeth.<sup>9</sup>

The occlusal view of the lines formed by the incisal edges of a talon cusp shows a “T”,

sometimes a “Y” and even an “X”, similar to a cruciform key.

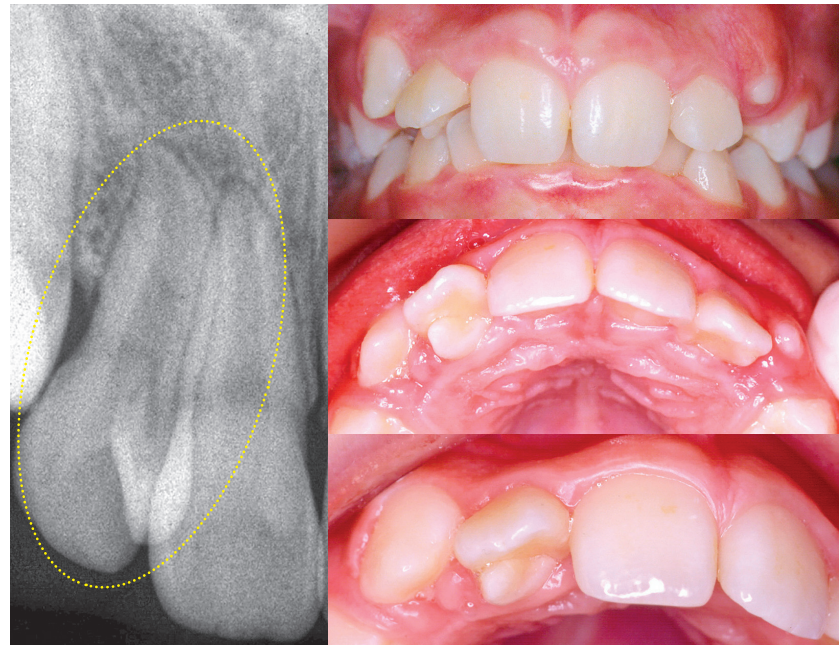
In addition to its classical shape of a talon, it may be clinically classified as conical, pyramidal or, still, as an enamel pearl<sup>13</sup>. According to its degree of formation and extension, talon cusps have been classified as: talon (type I), semitalon (type II) and tracetalon (type III).<sup>14</sup>





**Figure 8:** Talon cusp, a variant of dens evaginatus with occlusal surface in the form of a T, which may also be a Y or X. In opposite side, lateral incisor has similar rudimentary cusp.

**Figure 9:** Talon cusp in form of T disturbs occlusion. In opposite side, lateral incisor has similar rudimentary cusp.



They may affect aesthetics, complicate occlusal relationships and displace central incisors buccally because of their interference when these teeth erupt (Fig. 9). In some cases, the development of this anomaly is not complete, and, therefore, there is an appar-

### **Causes and mechanisms**

In general, it is bilateral and incomplete, but its different shapes in individuals in the same family suggest that the gene responsible for its occurrence has a reduced penetrance and variable expressivity.

Many of the cases described so far had a

### **Treatment considerations**

1. In many cases, gradual selective drilling every 6-8 weeks has good results, and dentin is exposed only during the time necessary for the deposition of reactionary dentin on the underlying pulp<sup>14</sup>.

ent prominent talon cusp, classified as pyramidal or conical. Sometimes its development is complete in one of the sides, while on the other, a cruciform shape, with four enamel crests, is evident.

family history, which indicates a hereditary cause. Talon cusps are often reported in cases of syndromes and associated conditions, and, therefore, are classified as a sign of a syndrome. However, special attention should be paid to it, because these may be only coincident findings.

2. Most cases require crown reshaping because of the extension of the anatomic deformation. During reshaping, special care should be taken with the pulp. However, an endodontic treatment may be necessary due to technical reasons, as, in most cases, there are pulp projections inside the talon cusp.

Treatment planning should:

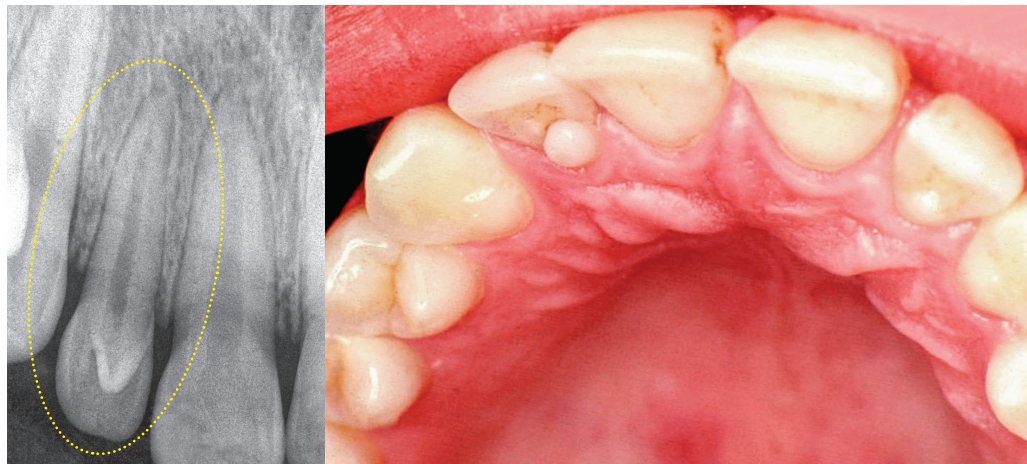
1. Preserve pulp vitality;
2. Meet aesthetic and occlusal requirements;
3. Prevent caries by sealing or eradicating grooves; and
4. Eliminate tongue irritation by making the surface smooth.<sup>9</sup>

### PROMINENT TALON CUSP

The cingula are, in general, tubercles or protuberances that make part of the lingual anatomy of permanent anterior teeth. How-

ever, in some cases, they may be enlarged (Fig. 10), which may suggest that they are an atypical, incomplete talon cusp. In such cases, these talon cusps are described as pyramidal, conical or as an enamel pearl.<sup>13</sup>

**Figure 10:** Unilateral prominent talon cusp, an atypical, incomplete type of talon cusp.



Talon cusps are classified as talon, semitalon and tracetalon according to their degree of formation and extension. Therefore, prominent talon cusps may be described as a mild manifestation of a talon cusp, as they have the form of a semitalon, or even a tracetalon (Fig. 10).

Prominent talon cusps have been associated with other anomalies, such as dens invaginatus, also called dens in dente, and the palatogingival groove. However, they are probably only coincident findings.

### MOLARIZED PREMOLARS

In some patients, premolars have a complex occlusal surface, with three cusps (Fig. 11) and are called molarized premolars, which suggests an atavistic trait. This atavism is the current manifestation of some traits of our ancestors, who supposedly had larger teeth and a more complex occlusal morphology. However, even the oldest fossils of our ancestors have not

Prominent talon cusps do not affect aesthetics or occlusion in most cases, but they may be reshaped when they cause discomfort to the patient, particularly when the cusp is unilateral, which generates bad tongue posture habits.

Treatment should 1. Preserve pulp vitality; 2. Meet aesthetic and occlusal requirements; 3. Prevent caries by sealing or eradicating grooves, and maybe even removing the prominent talon cusp; and 4. Eliminate tongue irritation by making the surface smooth.<sup>9</sup>

confirmed this hypothesis, which is, therefore, not supported by any evidence.

A case of molarized premolars is defined only when bilateral. The clinical and anthropological implications of molarization have been mentioned in several publications, but they have not been investigated very often.





Figure 11: Molarized premolars, assigned to a more complex occlusal surface morphology.

## FINAL CONSIDERATIONS

Supernumerary cusps have not been extensively studied in descriptive studies of clinical cases, and few cases have been recorded. Knowledge about their nomenclature and concepts is scarcely disseminated in general, although such knowledge is necessary because of the interventions required in many cases.

Lack of knowledge about them is why professionals and patients, in special, do not give them the importance that their corrections and adaptation should receive. The presence of a supernumerary cusp should be disclosed to the patient, stressing its importance and, especially, the treatment required to deal with the problem and to correct the anomaly, be it esthetic or functional. Clinical dentists should investigate the possible familial implications of supernumerary cusps to provide genetic counseling to the family.

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