TADs versus traditional devices and techniques in lower second molar uprighting procedures

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TADs versus traditional devices and techniques in lower second molar uprighting procedures

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Abstract

Impaction of the lower second molar is not a common problem. The prevalence of it is low ranging from 0% to 2.3%. The etiology of an impaction is various and it can involve systemic, local, and periodontal factors, as well as a developmental disruption of the tooth bud. Treatment options suggested in the literature are vary including leaving the tooth in situ, the extraction impacted second molar, orthodontic uprighting (surgically assisted or not), and autotransplantation. A review of various traditional and innovative orthodontic devices and techniques are hence exposed and compared to help clinicians solve this very challenging cases.

Introduction

Impaction of permanent teeth is a common clinical occurrence and may involve any tooth in the dental arch. The teeth most often impacted, in order of frequency, are the maxillary and mandibular third molars, the maxillary canine, and the mandibular second premolar. The impaction of the second mandibular molar is relatively rare and has a reported prevalence of 0% - 2.3% with a male and right sided predominance. The most common forms are unilaterally with a mesial, vertical and distal angulation (in descending order), usually associated to severe crowding. In fact, a very complex problem is the uprighting and subsequent eruption of the mesioangular impacted lower second or third molar. In the normal growth and development of the lower jaw, the molar tooth buds distal to the first permanent mandibular have a mesial inclination. This inclination is usually self-correcting as the anterior border of the mandibular ramus resorbs. Added to this, the mesial drift of the first permanent molar creates approximately 2.7 mm of space per side for angular adjustment and eruption. When this adjustment does not occur, second molar impaction results.

Several orthodontic therapeutic options have been proposed, priorly the need for third molar extraction should be evaluated. Frequently, the third molar position may impede the distal movement of the impacted molar, indicating the need for extraction. However, from a biomechanical perspective, sometimes it is better to leave the third molar bud to facilitate the second molar rotation.

Several traditional and innovative orthodontic devices have been advanced. The use of miniscrews in second molars disimpaction represents the culmination of a long period, starting from the seventies until today, has seen a succession of a number of therapeutic modalities with in order to restore a proper dental occlusion and to reduce the time of treatment. The choice of which biomechanic techniques is more suitable for each treatment needs is determined by factors such as the severity of inclusion of the second molar, the accessibility of the crown of the included tooth, the simplicity and the possible side effects on dental arch of the chosen mechanism of disimpaction.

Several articles were analyzed with the aim to compare traditional versus miniscrew biomechanic technique of second molar disimpaction.

Some of those traditional disimpaction devices used in the second molar uprighting, as reported in literature, consist in: titanium uprighting coil-springs (Sander's alike designed uprighting spring), crossed tipback springs, orthodontic elastic separating rings, "De Impactor", Distal jet, complex sectional or segmental, auxiliaries arch- spring techniques, straight wire - TMA wire sequences mechanics combined with surgical tooth crown exposure and elastic traction or specific wire bending loops. The most often recommended appliance for molar uprighting and extrusion is a simple tip-back spring, the length of the cantilever determines the moment- force ratio, and so the achieved movement. A short cantilever delivers more extrusion than a longer one.

In Table I are shown the main advantages and disadvantages associated with the use of traditional methods of uprighting.

Possible risks related to the uprighting procedures as referred by Gazit are:

- • the issue of the anchor and the side effects on dental intra- and inter- arch position;
- • the necessity for a disimpaction device that minimizes the risk for dental, bone and adjacent mucosal structures;
In 2008, Fernandes at al. used a removable retainer to disincluere the second molar, including but not very deep. The apparatus was constituted by lingual arch, hooks vestibular retention in correspondence of the first molars and first premolars, occlusal stops on the first molars and a spring uprighting wire realized with 0.028 anchored to a composite support polymerized on the visible surface of the tooth included. The disto-buccal cusp of the second molar was surgically exposed and an impression was taken of the entire jaw to build the device, the uprighting spring has been joined to the composite support and then turned every two weeks for 5 months, when it terminated the uprighting of the tooth. Advantages and limitations of this proposed equipment are:

- Risks associated with a surgical uprighting are reduced
- Need for a strenuous cooperation from the patient
- The hassle of using fixed equipment (which would have required a continuous bonding of new hooks, following the progress of disimpaction) is reduced.

Temporary anchorage devices are an alternative to traditional methods of uprighting techniques as a means to allow second molars uprighting, thus preventing unwanted dental movements in the same or opposite arch. It can be said that Branemark have pioneered the experimental work that has established the principle of osseointegration, with the study of titanium implants and the evaluation of their biological-mechanical characteristics on the insertion site. With the succession of numerous studies occurred the wide clinical spread of temporary anchorage devices (TADs), referring to all types of plants treated surface, mini-plates (surgical plates in situ from more miniscrews) and mini-implants (miniscrews) used for orthodontic anchorage purposes and subsequently removed once exhausted their function. Those devices are inserted into the bone and the traction of the tooth is performed with the aid of springs or elastic chains. Kanomi and Costa have introduced the use of miniscrews and mini-implants as a means of temporary anchorage, opening up new frontiers to the possibilities of orthodontic anchorage:

Table II. Advantages of miniscrews.

The skeletal anchorage, provided by devices such as implants or mini screws fixed to the bone, may be indirect (obtained by increasing the reactive support unit) or direct (by fixing the anchorage unit) both were found to be equally successful in 90.5% as reported by Melo.

Sohn and colleagues described a technique for uprighting using the mini-screw anchorage with an indirect technique: the choice of the indirect anchor avoids some drawbacks related to direct anchor such as pain referred at the force application site, the reduced effectiveness of the applied mechanism when the force vector intensity is reduced and the lack of utility in the upper jaw.

In contrast Lee et al. have promoted the use of miniscrew as direct anchorage changing the mini implant position in order to obtain two different types of force. The miniscrew can be positioned in the retromolar area, where it acts as a fulcrum for the traction by pulling distally to the second molar, or mesially to the same element where is the point of application of a tension force. It is important to know this dual possibility of use mini implant in molar uprighting taken in account the fact that the center of rotation of the second molar lies in the bifurcation of the roots of this tooth. In fact, in mild inclusion cases with mesial inclination of the crown, placing the mini implant in the retromolar area, it is possible to generate an effective uprighting sufficient to the complete straightening of the molar. Instead in moderate to severe inclusion cases, the generated moment is too small to produce a sufficient straightening of the tooth. For this reason it is essential to consider the possibility of placing the mini implant mesially to the included tooth so as a thrusting action force from mesial to distal in generated. The distalizing action force is due to an open-coil spring, replaced every 4 weeks. The third molar bud extraction is optional and required only if its contiguity is an obstacle to the eruptive course of the second molar.

Musilli et al. proposed three different methods of using mini screws for molar uprighting:

1. To place mini screw in the retromolar area and apply an elastic chain loaded between the screw and the molar;
2. To place a screw in the retromolar area and use a small cantilever active when intrusion and uprighting is performed;
3. To use a miniscrew placed a few millimeters mesial to the molar for controlling the vertical force produced by the long frontal teeth-uprighting tooth cantilever.

Discussion

The prevalence of impacted second molars is low, ranging from 0% to 2.3%. The etiology of impaction
can involve systemic, local and periodontal factors, as well as a developmental disruption of the dental buds. Several surgical and orthodontic treatment options have been suggested in literature as leaving the tooth in situ, removing it, orthodontic uprighting and autotransplantation of dental buds. Tooth impaction precludes its complete eruption and requires a proper uprighting treatment. Temporary Anchorage Devices allow disimpaction and the achievement of their final position, without the movement and reaction forces on other dental elements or the patient's compliance. Therefore it is clear that the anchorage control is one of the most important aspects of orthodontic treatment: in fact, success depends on the protocol anchorage differently planned for each single case. The introduction of mini-implants in orthodontics has solved the problem of patient's cooperation and ensure a safe and stable anchorage.

In conclusion, the use of miniscrews presents the following advantages:

- ease of use;
- lack of cooperation by the patient;
- reduced duration of treatment;
- good control of dental movements;
- requires the use of only a miniscrew or a bracket/button on the tooth surface, minimizing the discomfort of the patient;
- the insertion of the implant and the application of force can be effected in a single session (unlike conventional treatments that require taking the impression and a laboratory phase);

Furthermore, the supporters of the techniques of direct anchoring, highlight the simplicity of application of the forces compared to indirect anchorage, thus eliminating the possibility of any undesirable movement on anchoring teeth;

If the implant is inserted in the premolar area is reduced the need for third molar extraction.

In relation to third molars presence, Melsen and colleagues demonstrated that the third molar extraction can change the center of resistance of the second molar, inducing unwanted movement in the distal direction. In fact, in a computer simulation, it was revealed a significant mesial movement of the roots and a distal tip-back of the crown. However, the third molar bud presence can hinder the second molar uprighting movement, thus causing unwanted movement in the anchoring segment.

Finally, it is necessary to highlight some limitations in the use of miniscrews:

- In lingually inclined or rotated molars, the application of a single force may be insufficient to complete the straightening of the tooth, making necessary the application of different and more complex biomechanic systems of forces;
- The uprighting movement must always be carefully controlled to avoid unwanted movements on the buccal or lingual side;
- Miniscrew can not be used in extruded dental elements, because the system of forces necessary in this case is rather complex to apply. In these situations it may be more convenient the choice of traditional methods such as the application of an V arc or of a Sander's uprighting spring.

Conclusions

Second molar impaction is a very challenging therapeutic treatment issue. A proper clinical, radiological, and biomechanical evaluation and a thoughtful selection of the best orthodontic devices to apply and treatment mechanics, encompassing different levels of complexity, based on each single case features is necessary to grant successful treatment results.

References

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Illustrations

Illustration 1

Table 1: Advantages and disadvantages of the traditional methods of uprighting.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simplicity of use</td>
<td>Necessity of having the entire dental arch banded in order to get the proper anchor forces and biomechanism</td>
</tr>
<tr>
<td>Reducing the possible traumatism of the included tooth</td>
<td>Possible soft tissue irritation</td>
</tr>
<tr>
<td></td>
<td>Deformation or fracture of the spring</td>
</tr>
</tbody>
</table>
Illustration 2

Table 2: Advantages of miniscrews

<table>
<thead>
<tr>
<th>ADVANTAGES OF MINISCREWS</th>
<th>Excellent mechanical retention</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>The primary stability offered by mini-screw allows immediate loading with a light force and continues, more often developed with the use of nickel-titanium springs or elastic chains</td>
</tr>
<tr>
<td></td>
<td>The retromolar mini implant positioning in the disimpaction of second lower molars also offers significant biomechanical advantages given the proximity between the fulcrum of application and the center of resistance of the molar, facilitating the vertical control during the extrusion phase.</td>
</tr>
<tr>
<td></td>
<td>The use of springs in the nickel-titanium offers additional benefits such as the necessity of a smaller number of activation, therefore reducing the patient's discomfort and chair time, and the frequency of appointments.</td>
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<tr>
<td></td>
<td>Surgical procedures for mini implant's placement is well tolerated by patients with also a reduced risk of site infection</td>
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