Clinical Paper

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Clinical investigation of a mechanism for the classification of impacted teeth

Summary
Objective: Since January 2009, the EWC® system [18] has been produced and distributed by Adenta GmbH. This study was conducted to determine the stability of this system in the Classification of impacted and unerupted teeth.

Materials and Methods
36 patients (46 teeth) with the classification of displaced/impacted teeth were tested for reliability and side-effects.

Results
All displaced and impacted teeth were successfully relocated. No appliance debonded and no inflammatory reactions were recorded at the exit point of the tension spring from the mucosa.

Conclusion
The EWC® system provides a treatment method for the aligning of impacted and displaced teeth that is easy to use, reliable and efficient.

Introduction
A multifactorial process controls the process of eruption, even today many researchers agree that tooth eruption is a complex process. As a result, this complexity may cause teeth to shift, tooth retention and or interference.

In a random selection of test persons, after the wisdom teeth, the upper canines are affected with a frequency of 0.9 – 3%, and the upper middle incisors with a frequency of only 0.2%. [7, 8, 20]

The occurance of canine displacement varies in female patients with respect to the male at a ratio of 2:1 to 3:1. [1, 17]

There are many different traction appliance options for the alignment of impacted or unerupted teeth. Many have been studied and published in numerous papers. [5, 10, 11, 15, 16], they can be categorized 3 ways. [19]

1. Mechanisms for the initial extrusion
2. Mechanisms for the correction of deformities of first and second order
3. Rectangular arches wires for finishing.

Materials and methods
The EWC® spring system belongs to category 2, and functions in an active and passive capacity.

The active component consists of a 2.5 cm long stainless steel spring, with an outer diameter of 1.2 mm and an internal diameter of 0.75 mm. This active spring is pivot mounted to a lingual button, enabling the spring to turn in any direction 360 degrees. This spring has a power output of 32cN with 2mm activation.

The passive component is a 2 cm long piece of the same spring. This passive spring is sized accordingly and inserted over the arch wire. The arch wire must have a minimum dimension of .016 x .022 " Stainless Steel wire in a 0.18 " slot system for adjusting an impacted tooth. The maximum wire thickness the spring can accept is .017 "X .025 " or .020 "x .020" in an 0.22 " slot system.

Surgical Procedure
The position of the retained or displaced tooth determines the type of surgical procedure. [2, 6, 12]

In the case of palatally displaced teeth, there are two exposure techniques:

- open access
- closed access

For buccally displaced teeth, there are four techniques of exposure.

- Mucosal excision for a superficial location of the crown immediately below the attached gingiva
- Apically positioned flap for a superficial location of the crown at the join of the attached gingiva/free gingiva, or slightly higher
- Apically/laterally positioned flap when in the immediate vicinity of the root of the lateral incisor

* Closed process for high buccal location of the displaced tooth

In the case of a buccal location of the tooth, the button of the spring system is bonded on the buccal surface and orientated in the required extraction direction. It is important to ensure that no excess adhesive overflows around the pivoting lingual button, excessive bonding material will obstruct the rotational movement needed later in treatment. A trial activation should be performed to test the strength of the lingual button bond.

When pulling the spring by hand, visible elongation should be observed – this indicates a force between 100 and 150cN. If the bond holds, this positive test result indicates a reliable hold during the entire treatment process.

With a tooth dislocated palatally, the spring system has to be fixed at the palatal surface and orientated to the required tension direction to disto-buccal. Again, the trial activation should be performed.

Suture the flap back over the spring. Temporarily attach the end of the spring passively to the archwire with suture thread. After one week, the sutures are removed and the first activation is carried out.

Depending on the force direction for the alignment of the ectopic/retained tooth the anchorage point has to be chosen. Carefully place a ligature cutter on the auxiliary wire spring and close slightly in order to create a small gap within the spring coil in which the ligature wire will be fixed. Thus, the ligature wire cannot shift (Fig. 1a).

Fig. 1a

Cut the spring until the distance between the anchorage point and the tip of the spring is approx. 2 mm. This distance of 2 mm allows a force of approx. 0.32cN (Fig. 1b).

Fig.1b

Place a ligature cutter approx. 3-4 mm (3-4 loops) of the end of the spring and close slightly without cutting the wire in order to isolate 3-4 mm of the spring, then turn this part 45° in order to create a loop. Insert a ligature wire into the loop (Fig.1c).

Fig.1c

Fig.1d

The ligature wire is ligated at the attachment point. After four weeks the spring appliance should be cut by 2 mm in order to re-active the spring. This procedure should be followed until the tooth has broken through (Fig.1d).

Fig.1e

After the ectopic tooth has clearly broken through and the button of the EWC® spring is clearly visible, the clip of the EWC® should be carefully pulled of with a How or a Weingart plier. In case the lingual button unintentionally de-bonds, a new lingual button should be bonded at exactly the same palatal position (fig.1e).

Fig.1f

With a u-shaped chain the tooth will be moved buccally and de-rotated. Now a bracket or a button can be bonded buccally in order to continue extrusion (fig.1F).

Fig.2a

Fig.2b

Patient Examples

In the following clinical cases, a wide variety of cases will be presented with three patients.

Patient 1

Male patient age 17.6 years.
Angle class II overbite, palatal displacement of teeth 13, 23, Retention of the teeth 33, 43.

The EWC® lingual button was bonded with composite to the palatal surface (Fig. 2a). The spring was oriented to the disto-buccal and the wound sutured (Fig. 2b). The first direction of pull was disto-buccal (Fig.2c) until the canine was erected (radiograph).

At this stage of treatment the EWC® spring changed direction buccally (Fig.2d). Once the spring system was reduced to the extent that it could no longer be activated, this clearly indicated the time for the removal of the EWC® Lingual button. Further extrusion took place via a resilient rubber thread (Fig.2e). After

Further extrusion a lingual button was bonded to the buccal surface and tied with ligature wire (Fig.2f). Finally a bracket with a negative torque (-7) was applied. Axis correction and closing of the gap with a .017 "x .025" TMA archwire (Fig.2g). Final result after debonding (Fig.2h).

Fig.2c

Fig.2d

Fig.2e

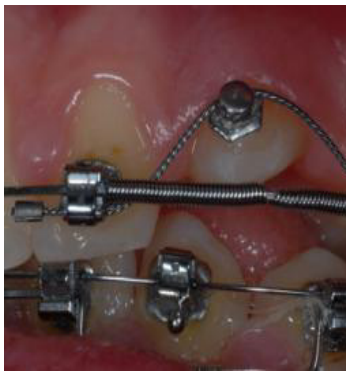

Fig.2f

Fig.2g

Fig.2h

Fig.3a

Fig.3b

Fig.3c

Fig.3d

Fig.3e

Fig.3f

After exposing the tooth, the extraction apparatus is attached to the buccal surface of the tooth positioned in the alveolar process (Fig. 3a). The EWC® spring was left passive fixed with a suture archwire and the wound closed (Fig.3b). Direction of pull was occlusal-buccal (Fig.3c) Every 4 weeks the spring was activated until the spring could not be reduced any further and the tooth was exposed. The EWC® spring (button portion remained) was carefully removed and the remainder of the extrusion was carried out with an elastic rubber thread (Fig.3d) attached to the EWC® button. The derotation and occlusal alignment is performed with a super-elastic segmented arch (Fig. 3e). Finishing with a 017″ x .025″ TMA archwire incorporating all the teeth (Abb.3f).

Fig.4a

Fig.4b

Fig.4c

Fig.4d

Patient 2

Male patient age 11.8 years.

Angle class II right, with displacement 21, midline displacement in upper jaw to the left (Fig. 4a).

After the distalization of the molars in the upper jaw with a Pendulum appliance, brackets were placed on the maxilla and mandible. Six months later, tooth 21 was exposed with a apical sliding flap and the EWC® spring/button attached (Fig.4b). The EWC® spring was activated at regular intervals (Fig.4c) until the tooth was exposed and a bracket could easily be bonded (Fig.4d). Final phase followed the same protocol as patient 1.

Fig.5a

Fig.5b

Patient 3
Female patient age 13.2 years.
Angle class II , 35 shift.

Initially tooth 35 was tipped distally and was up-righted occlusal within 3 months. The EWC® spring system could be seen through the mocosa (Fig. 5a). The procedure closly followed that of patient 1. After the tooth was fully exposed a bracket was bonded and the remainder of treatment was accomplished using a super elastic archwire (Fig.5b).

Results
In the period from January 2009 to September 2012 36 juvenile patients (18 female, 18 male) were treated, 46 displaced and /or impacted teeth were successfully treated.

They are assigned to the following groups:

Upper	tooth 3	29 patients	37 teeth
Lower	tooth 3	3 patients	4 teeth
Upper	tooth 5	1 patient	1 tooth
Lower	tooth 5	1 patient	1 tooth
Upper	tooth 1	2 patients	3 teeth

The anatomical position of the tooth determined the surgical process. The closed access via a mucoperiosteal flap was the method of choice due to the deep palatal and high buccal position. An apically positioned flap was used for the buccally positioned teeth in the area of the join of the attached/free gingiva. No EWC® springs broke and had to be replaced and no inflammatory reactions in the Mucosa over the EWC® spring or at the exit point were recorded.

Discussion
To prevent unwanted intrusion or tilting of adjacent teeth, appropriate transverse or sagittal molar anchorage must be of high priority. The process of creating space for the tooth to be aligned must be completed. When several teeth require extrusion anchoring quality is even more important. The use of mini screws is a perfect complement for Skeletal Anchorage. For extrusion of only one tooth the activated power of the EWC spring (32cN) coupled with an archwire of 016 "x .022" Stainless Steel in .018 "Slot system has proved to be optimum.

Data varies in much of the literature available [9,10,11] but lower force levels have been established. Becker recommends a force of 20 - 30cN, Kornhauser, a force of 24 cN/cm2 Root surface for tilting tooth movements. However, if the tooth is below the mucosa, the pulling force should not exceed 30 – 35 cN [3, 13].

The spring on the EWC® system generates an alternating passive and active force which provides two important advantages:

1 Mucosa or scar tissue can grow in between the separated spirals of a NiTi spring or chain, increasing the probability of inflammation and the loss of the appliance. Activation with the steel spring is low, the "tube form" is retained and mucosa or scar tissue is easily repelled. This allows the spring to contract and slide easily with little friction.

2 The strong rotation effect explained by Becker [3] when bonding palatal side of a palatally displaced canine was not experienced with the EWC® system. This was also not experienced in an experimental study specifically designed to measure this theory.

(Fig. 6) With a pulling force of approx. 0.3 N, and a distance of the lingual button of 2–3 mm measured from the longitudinal axis of the canine, this results in a torque of 0.6–0.9 N mm around the longitudinal axis of the tooth. The test verified that the rigidity of the steel spring creates a counter-torque of 0.75 N mm, and counteracts or prevents the aforementioned rotation. This effect can also be used in the case of distal movement of buccally displaced canines that are located labially to the root of the lateral incisor, and do not permit rotation.

Fig.6

Fig.7

((Fig. 7) Super-elastic springs, wire, or chains cannot establish this lateral stability owing to their high elasticity. Owing to the inhomogeneity of patients, an average handling time cannot be specified and was therefore not calculated.

Conclusion

The prefabricated technique of the EWC® system was used in the adjustment of 46 displaced/impacted teeth successfully. In addition to the simple application of force, clinical benefits include a secure attachment and thus elimination of adverse side effects.

For the patient, the EWC® system is pleasant and an easy-care solution that is not damaged even by the toothbrush or masticatory forces . Dental splints to correct crossbite of the tooth to be aligned were avoided.

In summary, the EWC® system a comfortable , economical easy to handle and reliable method that has proven itself in practice.

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