ORIGINAL RESEARCH

Influence of Oral Hygiene after Orthodontic Appliance Removal in Children Candidates to Hematopoietic Stem Cell Transplantation: A 10 Years' Experience

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Abstract

Objective: This cohort study aims to evaluate the impact of oral appliance removal on oral hygiene grade in children candidates to hematopoietic stem cell transplantation (HSCT) over a 10-year period.

Materials and methods: The following data from 213 medical records of children candidates to HSCT for newly diagnosed hemato-oncologic diseases were collected: age, type of hemato-oncologic disease, presence of removable or fixed orthodontic appliance, debonding protocol, simplified oral hygiene index (OHI-S) before debonding (T0) and after 7 days (T1).

Results: Out of 213 children candidates to HSCT, 44 patients (16.9%) wore an orthodontic device, in detail: 8 children wore a mobile appliance and 36 a fixed one. The removal of the fixed appliance was requested in six cases before performing magnetic resonance imaging (MRI) and in 30 cases before the conditioning. All the children underwent the same oral hygiene protocol after removing the fixed appliance. The OHI-S resulted significantly lower 7 days after the debonding procedure.

Conclusion: The removal of the orthodontic appliance before HSCT increases the oral hygiene grade of the children candidates to transplantation. A correct protocol must be followed in order to respect the hard and soft tissues.

Clinical significance: Orthodontic appliance removal before HSCT in children is recommended to ameliorate the oral hygiene grade of the patients, in addition, to prevent any form of traumatism on the oral mucosa.

Keywords: Appliance, Children, Cohort study, Transplant.

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Introduction

Children undergoing hematopoietic stem cell transplantation (HSCT) are at risk for oral complications, which may cause significant morbidity and potential risk of mortality. The Multinational Association of Supportive Care in Cancer/International Society of Oral Oncology (MASCC/ISOO) and the European Society for Blood and Marrow Transplantation (EBMT) developed guidelines to manage the activities that should be part of the patient's routine care during periods of cancer treatment, which are defined basic oral care (BOC).[1] The objectives of BOC, prior HSCT, are summarized in five steps: (1) prevention of infections of the mucosa and the periodontium; (2) reduction of pain discomfort; (3) maintenance of oral functions promoting oral nutrition and hydration; (4) reduction and management of the oral complications due to chemotherapy and radiotherapy; (5) improvement of QoL (Quality of Life).

In a matter of prevention of infections, Elad et al. suggest that in the first appointment, at least 2 weeks before HSCT, the dental healthcare should be aimed to ensure no traumatic procedures and to prevent anatomic factors that may induce pain during and after cancer treatment.[1] Therefore, as part of the dental evaluation, the dentist should eliminate potential sources of intraoral trauma such as deficient/rough restorations, dental calculus, mobile deciduous elements or non-restorable teeth, piercing, and orthodontic appliances. In case of a request for magnetic resonance imaging (MRI), before the transplant, the orthodontic appliances must be removed earlier.

Fixed orthodontic appliances are usually composed of stainless or nickel-titanium (NiTi) wires and metal brackets or bands, which are attached with composite resins to the surface of the teeth or with GIC/resins for bands on molars. The removal of the brackets and composite resin (that is "debonding") is an important process and requires a precise protocol to keep the dental surface intact (as it could be micro-fractured for an improper practice) and avoid resin residuals, which may favor plaque deposition, increasing the risk of caries and gingivitis.[2] This study aims to evaluate the impact of orthodontic appliance removal on oral hygiene grade in children candidates to HSCT.

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Materials and Methods

This cohort study was carried out collecting information from 213 medical records of children candidates to HSCT for newly diagnosed haemato-oncological diseases and attending the Department of Pediatric Hematology/Oncology of Brescia from January 2007 to December 2017.

Data Collection

For each patient's medical record, the following data were collected: age, type of haemato-oncologic disease, presence/absence of removable or fixed orthodontic appliance, reason for the removal of the device, debonding protocol, simplified oral hygiene index (OHI-S) by Greene and Vermillion[3] at the moment of debonding (T0) and after 7 days (T1).

Compliance with Ethical Standards

The study was planned and carried out in compliance with the declaration of Helsinki and good clinical practice. All the parents were informed about the debonding procedure and signed an informed consent before.

Data Analysis

Data were entered in an informatics database. The statistical analysis, when needed, was performed with the Chi-squared test for significance. The results were considered statistically significant for a p value <0.05.

Results

Table 1 summarizes the demographic characteristics of the children at the moment of the HSCT. A total of 213 children (95 females and 118 males, middle age 6.32 ± 2.2) have been transplanted, out of which, 34 children under 5 years old, 117 children from 6 years to 12 years old, and 62 teenagers from 13 years to 17 years old.

Over a period of 10 years, out of 213 patients, 44 patients wore an orthodontic device before conditioning, in detail: 8 children wore a mobile appliance and 36 a fixed one (Table 2). In this latter, removal of the fixed appliance was performed. In six cases, the removal was requested before performing MRI, in the remaining cases before the conditioning. All the children underwent the same protocol to remove the fixed dental appliance (Table 3). At T0 the mean of OHI-S was 2.6 ± 0.7, while at T1 was 0.6 ± 0.4 ($p < 0.05$).

Discussion

The request for the removal of an orthodontic appliance in children who are candidates for HSCT can arise from the diagnosis of haemato-oncological disease, due to the need of performing an MRI (when requested by the radiologist), or before the transplant to eliminate possible traumas to the oral mucosa.[4] Out of 36 patients with the fixed appliance, in 6 cases, the removal was requested before performing MRI while in the remaining 30 cases before the conditioning.

As regards MRI, metal orthodontic appliances cause more signal loss and image distortion as compared to ceramic and titanium ones. Stainless steel and large brackets, in addition to the oriented miniscrews in relation to the axis of magnetic field, may cause more severe signal loss and image distortions. Moreover, gradient echo and frequency-selective fat saturation MRI protocols are more susceptible to metal artifacts. Stainless steel brackets and wires, lingual or palatal arches may cause, in addition an increase of thermal damage of the hard and soft tissues of the oral cavity. Removal of braces, due to medical purposes that require MRI, should be evaluated on the basis of the distance of the anatomic area that must be imaged and the MR protocol. Titanium, ceramic, composite brackets and wires are considered, most of the time, MR safe.[4]

As underlined by the international guidelines, it is advisable to remove any type of orthodontic appliance in children who are candidates for transplantation.[1]

Table 1: Demographic characteristics of the patients

Patients (n = 213)	
Male	118 (55.3%)
Female	95 (44.7%)
Mean age	5.32 ± 2.2
Disease (n = 213)	
Acute lymphoblastic leukemia and related precursor neoplasms	17
Acquired bone marrow failure	10
Congenital bone marrow failure	2
Chronic myeloid leukemia	2
Familial hemophagocytic lymphohistiocytosis	4
Hemophagocytosis	1
Hemoglobinopathy	7
Histiocytic disorder	1
Hodgkin lymphoma	7
Inherited disorder	11
Myelodysplastic/myeloproliferative neoplasm	2
Myelodysplastic syndrome	6
Myeloproliferative syndrome	1
Non-Hodgkin lymphoma	3
Precursor lymphoid neoplasms	18
Primary immune deficiency	86
Secondary acute leukemia	1
Solid tumor	34

Table 2: Orthodontic appliance removal

	No. of patients with removable orthodontic appliance	*No. of patients with fixed orthodontic appliance*	*No. of patients without orthodontic appliance*
No. of patients (%)	8 (3.75)	36 (16.9)	169 (79.35)
Males	2	17	96
Females	6	19	73
Mean age	5.2 ± 1.2	9 ± 2.3	12 ± 2.2

Table 3: Debonding protocol

a	Detachment of the brackets using bracket remover pliers: the active plier tips are positioned in the vertical (occlusal-cervical) direction of the bracket, performing closing movement and smooth twist of the pliers
b	Removal of the adhesive remnants by using a tungsten carbide 24-blade high-rotation drill, positioned parallel to the long axis of the tooth, making lateral movements in the mesiodistal direction of the crown
c	Polishing of the teeth with pumice at low speed
d	Professional oral hygiene session, with careful respect for the gingival tissues: polishing with cup and micro-abrasive paste, reserving ultrasounds only for areas of hard deposits (that is retro-incisal and upper molar buccal surfaces)
e	Professional fluoride foam for 4 minutes in the upper and lower dental arches to improve the mineralization degree of the teeth

The main reason is to avoid traumatic events for the oral mucosa (detach of brackets, stinging of long wires) but also to eliminate plaque accumulation and the entry of bacteria into the deep tissues.

In our survey, over a period of 10 years, 213 children underwent an HSCT: 36 children (17 males and 19 females) needed the removal of fixed orthodontic appliances while 8 children (2 males and 6 females) had a removable appliance that was recommended not to wear during transplantation.

From our results, about 16.9% of children candidates to HSCT needed the removal of fixed orthodontic appliances. The introduction of direct bonded orthodontic attachments with composite resin has had a significant impact on the practice of orthodontics. This type of treatment is based on the bonding of accessories to the dental crown, by means of acid etching of the enamel surface, which creates microporosities, thus promoting micromechanical retention of the adhesive to the enamel structure.[5] Some advantages include better gingival health, greater patient comfort, and improved clinical efficiency.[6] Though there are many advantages of resin-bonded orthodontic attachments, there is at least one disadvantage: the resin used to bond the brackets can permanently alter the surface of the enamel.[7–12] Additional evidence shows that direct bonding can result in a color change of the enamel depending on the depth of the resin tags remaining after adhesive removal.[13] After detachment of the brackets, at the end of the active orthodontic treatment, a certain amount of adhesive remnants must be mechanically removed from the enamel, as they favor bacterial plaque retention and create color change over time.[14]

According to Cardoso et al., the ideal material to remove the adhesive remnants from the dental enamel must have a greater hardness than that of the adhesive, and smaller than that of the enamel.[15] However, according to Zarrinnia et al., the removal of the adhesive remnants can cause an erosion depth of about 19 μm on the enamel surface.[16]

A recent study found that the use of tungsten carbide 24-blade multi-laminated high-rotation drill without water had the best results in relation to the adhesive remnant removal after the bracket debonding.[2] These results are consistent with those of Leão Filho et al., who compared only multi-laminated, high- and low-rotation drills.[17] A systematic review of the literature has demonstrated that high-rotation tungsten carbide drills are the most commonly used because they are more effective and require shorter working time compared to other methods.[5]

In our protocol, after bracket debonding, the adhesive remnants were removed by using a tungsten carbide 24-blade high-rotation drill. Then teeth were polished with pumice, and a professional hygiene oral session was performed with careful respect for the gingival tissues. Ultrasounds were used only for areas of hard deposits, and professional fluoride foam was applied to improve the mineralization of the teeth.

For each patient, the grade of oral hygiene before the debonding procedure and then after 7 days was noted, using the OHI-S. According to our results, a significant reduction of the OHI-S was found 1 week after the orthodontic appliance removal. This is in agreement with a recent study[18] on the changes of salivary periodontal pathogens in adults after orthodontic treatment removal: Kim et al.[18] reported an improvement of the clinical periodontal parameters and especially they found a significant reduction of the salivary bacterial levels (*Aggregatibacter actinomycetemcomitans*, *Fusobacterium nucleatum, Porphyromonas gingivalis*, *Prevotella intermedia*, *Tannerella forsythia*) 1 week after debonding. The reduction of the salivary bacterial levels is desirable in children candidates to HSCT, in order to prevent infections. Therefore, orthodontic appliance removal before pediatric HSCT is to be recommended both to prevent any form of traumatism on the oral mucosa and to ameliorate the oral hygiene grade of the patients. A correct protocol for debonding must be followed to respect the hard and soft oral tissues in pediatric patients candidates to HSCT. Currently, there are no studies discussing protocols for orthodontic appliance removal prior to transplantation, although recommended in the MASCC guidelines. Future studies discussing different debonding protocols are desirable.

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