Orthodontic treatment in oncological patients

The progress in oncological treatment has led to the current increase of childhood cancer survival rate to 80%. That is why orthodontists more and more frequently consult patients who had completed a successful anti-cancer therapy in childhood. Oncological treatments such as chemotherapy, radiotherapy or supportive immuno-suppressive therapy cause numerous side effects in growing patients, connected i.a. with growth, the development of teeth or the viscerocranium. This is a special group of patients that needs an optimised plan of orthodontic treatment and often has to accept a compromise result. The purpose of the current work is to discuss the results of orthodontic treatment in patients after an anti-cancer therapy. Time of treatment was 12.5 months. In 6 patients (from 40 undergoing orthodontic therapy) we haven’t reached a normocclusion, in 9 patients we should have stopped the therapy because of the recurrence. In 11 patients we found mucosa inflammation and in 1 patient the therapy stopped before the end because of very low oral hygiene level. Bearing in mind the limited number of original works on the above topic in Polish medical literature, the study has been carried out in order to make Polish orthodontists more acquainted with the topic and the standards of dealing with an oncological patient.

Introduction
Orthodontic treatment is a specific stomatological procedure, currently aimed at patients of all ages, especially children, teenagers and young adults. Oncological patients are a specific group that an orthodontist may encounter in their practice. Remarkable progress in oncological treatment has increased the survival rate of childhood cancer to 80% [1]. It is thus estimated that 1 in 1900 young adults had undergone a successful oncological treatment in childhood [1]. Among causes of death in children cancer is on the second place just behind accident-related trauma and poisonings. Childhood cancer cases constitute 2% of all diagnosed cancers. The number of new cancer cases in children in Poland does not vary significantly and is 1200 per annum (i.e. 105-130 new cases per 1 million children). The number of brain tumours, leukaemias and neuroblastomas is increasing slightly [2].

As follows from the above, it is highly probable that in the era of rapid medical progress, high expectations from life and the wish to improve the standard of living, patients with cancer history, just like their healthy peers, will be looking for a possibility of orthodontic treatment. Oncological patients consulting an orthodontist can be divided into three groups:

2. Patients receiving supportive care.
3. Patients undergoing an active oncological treatment (primary cancer, relapses).

The main component of oncological treatment of childhood cancers is chemotherapy (general treatment) which, complemented by radiotherapy (local treatment) and surgery (local treatment), is the basis for combined cancer treatment. The results of this treatment may appear immediately
or several months after its completion. Fifty percent of treated patients experience delayed adverse effects of the therapy [3]. They may be caused by the cancer itself, by the prescribed treatment such as chemotherapy, radiotherapy or supportive care that includes transfusions, antibiotics and immunosuppressive treatment as well as by combinations of the above. The extent of adverse effects in a given individual depends on the patient’s age, the location and size of the primary malignancy at the time of diagnosis and also on the type and intensity of treatment [4]. In addition, genetic susceptibility may escalate side effects of the applied therapies. Dahllof and Huggare state that among patients 3.5 to 16.9 years of age treated for malignant blood cancer with the help of a bone marrow transplant 93% had 1 or more adverse effects and 73% had 3 or more. On average, 1 patient experienced 3.7 side effects and the number increased to even 5 in patients who had undergone full body X-ray irradiation [5].

The most frequent side effects of oncological treatment undeniably related to orthodontic treatment include:
- inclusions/disorders/asymmetrical growth of the viscerocranium both within its hard and soft structures, especially sagittal and vertical measurements of the skull, reduction of S-N, S-Pog, Art-Pog lengths
- reduction of the midface size,
- growth disorders of the maxilla and mandible – reduction in size of the alveolar process of the maxilla and mandible,
- temporomandibular joint (TMJ) disorders,
- reduction of the length of pubertal growth,
- inhibition of tooth development,
- tooth pathologies (microdontia: 19% incisors to 45% second molars),
- hypodontia/oligodontia/odontotia,
- demineralisation of the hard tissues of the teeth (white spots, caries),
- shortening of dental roots – V-shaped roots,
- premature closing of root canal apices,
- root resorption,
- tooth mobility.

Additionally, side effects also appear within mucous membranes:
- inflammations of the mucous membranes,
- ulcerations,
- bacterial/fungal/viral infections, xerostomia.

All the above-mentioned adverse effects of oncological therapy predispose to developing such malocclusions as crowding of teeth, crossbites, open bites, class II skeletal malocclusions and asymmetries [6]. Orthodontists consulting patients with cancer history have to bear in mind potential adverse clinical implications and a significant risk of complications during orthodontic treatment. Aside from the above side effects, anti-cancer treatment additionally results in a significantly lessened resistance to infections and the atrophy of the oral mucosa. As a result, these patients are prone to a higher risk of complications caused by anything that may irritate the surface of the mucous membrane, which has to be taken into account while planning the orthodontic treatment of such patients.

**The aim of the work is to discuss orthodontic treatment results of oncological patients.**

**Material and Methods**

The study includes patients who came for an orthodontic consultation in the years 2008-2012. Fifty-three patients with cancer history were singled out. Four patients delayed treatment and in 9 patients the cancer relapsed. Ultimately, the study focused on 40 patients: 17 girls and 23 boys. Orthodontic profile of the focus group: crowding in the upper and lower dental arches was diagnosed in 31 patients, 26 of which had skeletal class II and 5 – skeletal class III, 8 so-called high-angle patients and 9 patients with tooth pathologies. Oncological profile of the focus group: 23 patients had undergone a complete oncological treatment in the past, 17 patients were in the process of receiving supportive care, 11 people had cancer of the head and neck. Twenty-three people suffered from leukaemia, out of which 40% had ALL (acute lymphoblastic leukaemia), 30% CML (chronic myeloid leukaemia), 30% CLL (chronic lymphocytic leukaemia). 10 people had brain tumours, out of which 60% were gliomas, 30% gangliocytomas, 10% medulloblastoma. 3 people struggled with rhabdomyosarcoma, 2 with neuroblastoma and 2 with lymphomas.

The study evaluated the following:
- duration of orthodontic treatment,
- reaching an orthognathic norm – symmetry lines, canine class I on both sides, proper lateral incursion, correct overbite and overjet,
- reaching the correct tooth alignment,
- reaching/not disturbing the soft tissue profile,
- complications.

**Results**

**Duration of orthodontic treatment**

The average duration of treatment in the focus group was 12.5 months. In 9 patients the treatment had to be finished earlier in order to actively treat the relapse of cancer. **Reaching an orthognathic norm**

In 6 patients in the focus group the so-called orthognathic occlusion, i.e. symmetry lines, canine Class I, Angle’s class I, overbite and overjet, was not reached. **Extractions**

In 2 patients single tooth extractions were performed without complications.

**Need for imaging examinations**

During orthodontic treatment 9 patients required imaging examinations. In these cases brace elements were temporarily removed. 23 people did not need imaging tests. Eight patients had aesthetic brackets which did not need to be removed for imaging tests. **Complications. Inflammation of the mucous membrane**

In 11 patients from the focus group and in 3 patients of the control group the inflammation of the oral mucosa was diagnosed and 1 patient had to have their braces prematurely removed due to a severe inflammation of the oral mucosa and the lack of proper dental hygiene.

**Root resorption**

No cases of pathological root resorption were diagnosed either in the focus or control group.

**Discussion**

The conducted study shows that the results of a correctly administered orthodontic treatment of oncological patients do not significantly vary from the treatment results of healthy patients. The key factor is close interdisciplinary cooperation with doctors conducting oncological treatment, which, after examining the patient and analysing their medical and treatment records, allows to plan orthodontic treatment accordingly. Treatment plans have to be individualised and modified to include the needs of oncological patients. Frequently the treatment involves a compromise. Treatment length in the oncological focus group was relatively shorter. No serious mid- or post-treatment complications occurred. One of the most serious and acute complications of radiotherapy of the head and neck cancer is osteoradionecrosis (ORN), clinically defined as X-ray induced bone and surrounding tissue damage in the form of ulcerations or necrosis that progresses or continues for over 3 months [7]. According to Reuther, Schuster and Mende, ORN occurred in 8.2% of cases in adults after the radiotherapy of the head and neck. In 50% of cases it occurred after tooth extractions. It was three times more frequent in boys, being localised mainly in the body of mandible. Risk factors increasing the probability of ORN occurrence include: high grade of the tumours, segmental ressection of the mandible and radiotherapy before and after a tooth extraction. It is believed that atraumatic tooth extractions reduce the risk of ORN, ORN in child cancer patients has not been described as yet [8]. MRI (magnetic resonance imaging) plays a very significant role in diagnosing pathological changes in the head and neck. The compatibility of fixed appliances with this test is still being discussed. So far, there have been no reports about complications connected with orthodontic braces while carrying out an MRI test. However, the braces themselves may cause significant artifacts [9]. In order to minimise the distortions of the image, removable steel elements (i.e. archwires) need to be removed. Brackets and bands, steel ties, cobalt, chrome, titanium, molybdenum and nickel alloy archwires may stay. Permanent retainers have to be carefully inspected in terms of the quality of fixing. While planning orthodontic treatment in patients who will probably need to have MRI tests, especially when such tests would be repeated regularly – and this group definitely includes cancer patients – the use of aesthetic braces without metal components has to be seriously considered. It will significantly reduce the occurrence of distortions during the test [10]. In order to limit the exposure to X-rays it is possible to use already existing (done for oncological reasons) patients’ NMR tests for the diagnostics, planning and follow ups of orthodontic treatment. Tymofiyeva Olga et al. evaluated the usefulness of contrast MRI
imaging of the head and neck in children. They found the above test highly useful in evaluating various dental pathologies and in planning orthodontic or surgical treatment. In comparison with conventional radiography, MRI ensures three-dimensional imaging and completely eliminates ionising radiation, which is particularly important in children who need frequent tests [11]. Antibiotic prophylaxis is not routinely recommended for oncological patients. Introducing an antibiotic needs to be considered in patients with additional internal problems and in patients receiving supportive care. The procedure must always be agreed with the doctor in charge of the oncological treatment. In our group 5 patients were prescribed prophylactic antibiotic therapy (amoxicillin + clavulanic acid) before the application of bands. It clearly follows from the research done by two research groups in the United Kingdom (Hobson and Clark, 1995) and the USA (Gaidrey et al., 1995) that the risk of developing bacteremia is much higher when applying the bands than removing them [12]. As mentioned above, oncological treatment increases the risk of infection and lesions including ulcerations within the oral mucosa even with minor irritation. Moreover, as a consequence of frequent salivary gland dysfunctions and the reduced amount of secreted saliva, the efficiency of cleansing declines and the risk of caries increases [13]. Appropriate dental hygiene is an absolute must. Patients have to be properly instructed and motivated to maintain perfect hygiene. It falls to the patient to brush and floss the teeth, to use 0.2% chlorhexidine mouthwash, protective waxes and silicones in order to prevent the damage to the mucous membrane. The orthodontist’s responsibility is to make sure that the applied braces are ergonomic, to ensure additional fluoridations and prescribe mouth moisturisers. Shortening of root apices as a particular type of external root resorption can often be observed after orthodontic treatment. The significance of the malocclusion type or the morphology of tooth roots in the occurrence of resorption has not been conclusively proved. A more important role is ascribed to long-lasting orthodontic treatment predisposing to the occurrence of shortening of roots [14] rather that their initial anatomy. Using a low level of orthodontic forces is one of the methods to minimise the induction of resorption. Levander et al. [15] showed that a 2-3-month break in the treatment after 6 initial months of active therapy may lessen the number of patients experiencing extensive root resorption. Over the course of 14.1 years Remington et al. [16] observed 100 patients who experienced dental root resorption during active orthodontic treatment. They did not notice a significant progress of resorption after finishing the treatment although a noticeable transformation of root apices of the teeth did take place. Even teeth with severe resorption functioned correctly and only 2 patients experienced increased mobility. General recommendations for all root resorption prone patients suggest taking follow-up X-ray pictures after 6 months and suspending the therapy for 2-3 months. Brackets should not be removed and archwires should remain passive [17,18].

Conclusions
Orthodontists treating oncological patients have to bear in mind the following principles:
1. Orthodontic treatment should not be started earlier than 2 years after completing the anti-cancer treatment. It is connected with the risk of developing a secondary cancer, which happens in 2.6-12.1% of cases.
2. The treatment plan has to be adjusted to suit the general state of the patient’s health and as consistent with the patient’s expectations as possible.
3. The mechanics of the treatment should be as simple as possible, using low forces and reducing the risk of tooth root resorption.
4. Using aesthetic brackets instead of metal ones (they give off smaller artifacts during imaging examinations), possibly clear-aligners (in selected cases).
5. Often a compromise result of the treatment needs to be accepted.
6. It is suggested to limit the treatment to the upper dental arch only – due to shorter pubertal growth and inhibited growth of the mandible the treatment of class II cases especially is extremely difficult and modifying the growth may prove impossible.
7. Patients should be particularly motivated to maintain ideal dental hygiene because due to a reduced saliva flow they are more prone to caries. It is recommended to eliminate elastics and prescribe fluoride products and mouth moisturisers.

References