Does "CIOTIPlus" only mean "brushing twice"?

Caries and periodontitis are biofilm associated diseases with multifactorial causes (etiology). They are still among the most common diseases affecting the general population. A major factor in the development of oral disease is related to biofilm; this is why the efficient removal of biofilm, in addition to regular dental check-ups and nutritional guidance, plays a major role in the prevention of oral disease. The removal of biofilm is not just up to dental professionals [4], but rather, the principal responsibility of the patient through regular home-based oral hygiene [6].

Nevertheless, the quality of home-based plaque removal can be described as inadequate for large parts of the population. Many dental professionals recommend the "Modified Bass Technique" for the mechanical removal of plaque using the toothbrush. However, this technique is difficult to learn. In literature, for example, no evidence can be found indicating that this technique is superior to the "horizontal scrubbing technique" with respect to plaque removal [5, 19, 25]. When employing manual as well as electric toothbrushes, it is agreed that compliance with a system of brushing is more important than adherence to a particular technique [5]. The regular implementation of a certain brushing system prevents that teeth, or tooth surfaces, are not accounted for during home-based oral hygiene [20].

As early as 1948, Bass recommended a systematic approach for brushing teeth [3]. Especially because the oral surfaces of mandibular teeth often display more hard and soft deposits than other tooth surfaces and are evidently neglected during home-based oral hygiene [17], cleaning should begin with the inner tooth surfaces during tooth brushing [17, 18]. Yet, our observations [8, 9] together with the findings from other studies have shown that patients primarily clean the vestibular surfaces first [8, 12]. Van der Sluijs et al. (2018) could determine that, in terms of plaque reduction in young patients with periodontally healthy dentitions, there was no significant difference whether or not the patients cleaned the oral or vestibular surfaces first [23].

To date, there is no clear data in literature with respect to the duration and frequency of tooth brushing [2, 6]. However, a "twice-daily, two-minute" brushing is generally recommended. Studies have shown that brushing twice daily with fluoride-containing toothpaste has a higher caries-preventive effect and reduces caries incidence more than brushing once daily [6, 10, 13]. Additionally, it has been shown that more plaque removal occurs by increasing brushing duration and employing manual as well as electric toothbrushes [15, 24, 26]. It has been observed that tooth brushing for one and two minutes achieves an average plaque reduction of 27 % and 41 %, respectively [21].

The Department of Conservative Dentistry, Periodontology and Preventive Dentistry of the Hannover Medical School introduced the "IOC-TIPlus" brushing system in 2007. However, based on clinical observations, this system was changed to "CIOTIPlus" in 2009. Using this system, the patient first brushes the **c**hewing, followed by the **i**nside and the **o**utside surfaces of the teeth with a toothbrush. Afterwards, the **t**ongue and the **i**nterdental spaces are cleaned with interdental hygiene tools. Following this cleaning procedure, the patient systematically brushes the tooth surfaces using circular/rotation movements again ("**plus**") with the same (pea-sized) amount of fluoride-containing toothpaste (Fig. 1). This brushing system is not a "double" brushing in the literal sense because the entire cleaning process is not repeated in the same manner. By re-applying fluoride-containing toothpaste, the tooth surfaces are mechanically cleaned once again on the one hand, while an additional fluoride dose is supplied on the other hand; indeed, the effect of fluoride is higher on clean, plaque-free tooth hard substance [11].

The individual steps of the brushing system and technique for dental and oral hygiene are explained in detail below:

Before beginning tooth cleaning, the patient should first rinse his/her mouth vigorously with water. This ensures that coarse, non-adherent food particles are already removed from the mouth. Patients also have very different saliva qualities. Thus,

Translation: Christian Miron
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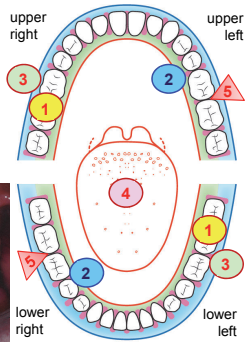
DOI.org/10.3238/dzz-int.2019.0127–0136

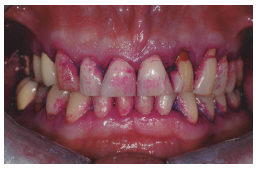
Zentrum Zahn-, Mund- und Kieferheilkunde

Klinik für Zahnerhaltung, Parodontologie/Peri-implantologie und Präventive Zahnheilkunde

➢ *Tooth Brushing System and Technique for Adults* ➢

C I O T I Plus

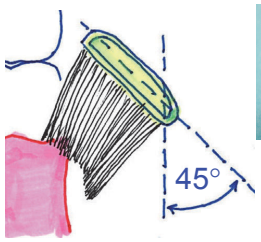


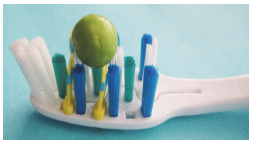


Before brushing

First rinse your mouth vigorously with water before brushing

Staining if necessary (disclosing tablets, etc. in order to make the plaque visible) **rinse with water**

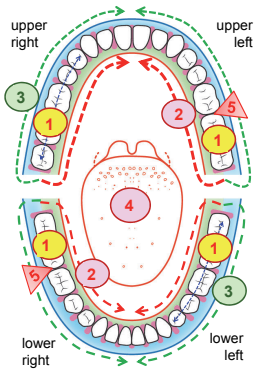


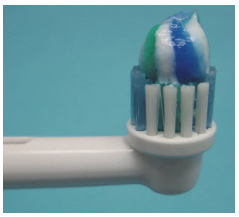


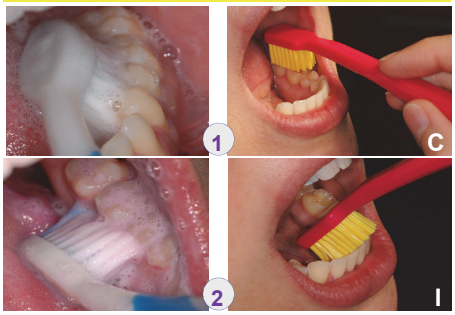
„pea-sized“ toothpaste

Basic rule **"*from red to white*"** brushing from the gum **vibratory** or **small circular** motions towards the chewing surface!
→ **Do not scrub!**
Brush with toothpaste 2 times dally
(fluoride content 1000-1500 ppm)

Use of an electric toothbrush





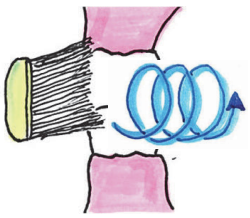


Step 1
apply the toothpaste and brush the **Chewing surface**
(scrubbing is allowed here)

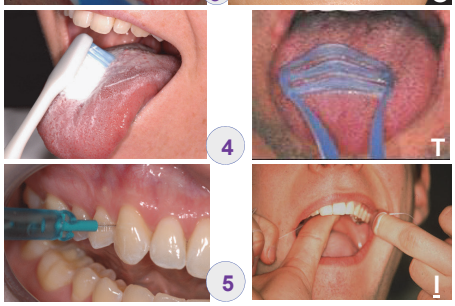
Step 2
brush the **Inside**

Step 3
brush the **Outside**

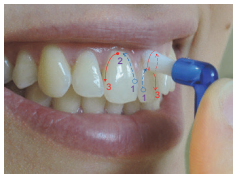
Step 4
clean the **Tongue**



An individualization of the toothbrushing-technique or oral hygiene at e.g. periodontally damaged dentition should be done by the dental professionals!



Step 5
clean the **Interdental Area**



In addition!
→ **Solo technique** with round **tuft-brush:** brushing in small circular movements along the gingival margin beginning on one side of the tooth (blue arrow[1]) to the other side of the tooth (red arrow[2-3]) under very light pressure!

Step 6 (Plus)
In order to increase the effect of the fluoride and cleaning after first brushing, as a **last step** (more in the evening) you should brush the gums and the teeth (**c**hewing / **i**nside / **o**utside surfaces) with the same amount of toothpaste (*pea-sized*), applying evenly in rotating movements once again. . Then rinse with a sip of water through your teeth for 30 seconds.

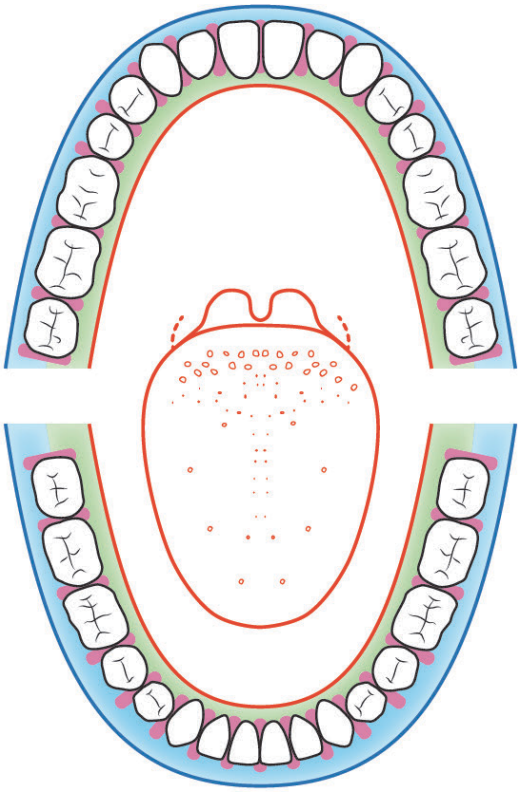
H. Günay-Okt.2007/Jan.2019

Figure 1 Tooth brushing system and technique for adults (CIOTI Plus).

Tooth Brushing System and Technique for Adults

CIOT I Plus

➢ Please treat the marked areas with special attention, clean them carefully and effectively! → → → →



We recommend the use of the following articles*

O Multitufted toothbrush (e.g. .....)
O Single toothbrush (e.g. .....)
O Unwaxed / waxed dental floss (e.g. .....)
O Superfloss-dental floss (e.g. .....)
O Interdental brushes (e.g. .....)
O Soft Picks (e.g. .....)
O Tongue cleaner/scraper (e.g. .....)
O Electric toothbrush (e.g. .....)
O Fluoride-containing toothpaste (e.g. .....)
O Toothpaste for sensitive tooth (e.g. .....)
O Fluoride gel (e.g. .....)
O Fluoride rinsing solution (e.g. .....)
O Chlorhexidine rinse solution (e.g. .....)
O Plaque disclosing tablets (e.g. .....)
O Mouth healing ointment (e.g. .....)
O Others (..... .....)

**All these items can be purchased in drugstores and / or pharmacies.*

Kindly yours

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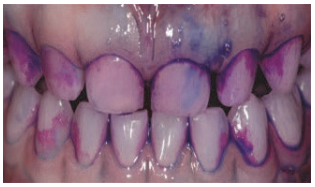
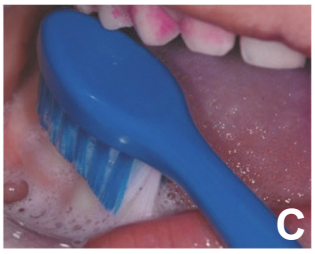
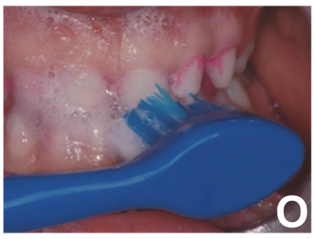
Tooth Brushing System and technique for Kids - C O I Plus

Chewing surface – Outside – Inside – re-brushing







Vigorously rinse mouth with water before brushing

If necessary, stain the plaque
(disclosing tablets in order to make the plaque visible)

apply the toothpaste and brush the
Chewing surface
(scrubbing is allowed here)

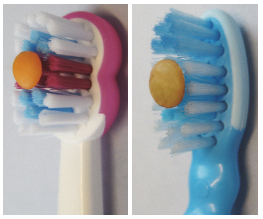
brush the Outside
The child "draws" circles on the outside surfaces

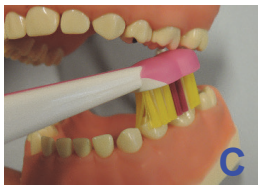
and

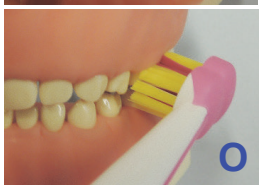
brush the Inside
They are "swept out"
(like a hand brush)
from red to white
in (small) **circular motions**

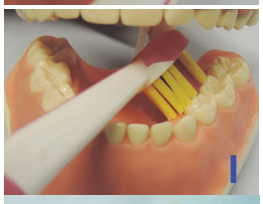
as a last step (**Plus**)
Control and re-brushing
by the **parents***)

Basic rules is **"from red to white" from the gum in small circular motions** to the chewing surface!









How often should children be brushed?

With the eruption of baby's first teeth: 1x dally (evening) with a small lentil (or rice grain) sized amount of children's toothpaste (fluoride content: 500 ppm) and
from 2nd Birthday 2 x daily (morning and evening) with a small pea sized amount of children's toothpaste (fluoride content: 500 ppm).

*)In order to increase the effect of the fluoride and the cleaning, the parents should brush (rather in the evening) after first brushing once again in rotating movements, the gums and teeth (**c**hewing / **o**utside / **i**nside surface) with a slight amount of toothpaste. Then rinse with a sip of water.

Beginning with elementary school: 2x dally with adult toothpaste (fluoride content: 1000-1500 ppm) use a tooth brushing system (CIOTIPlus)!

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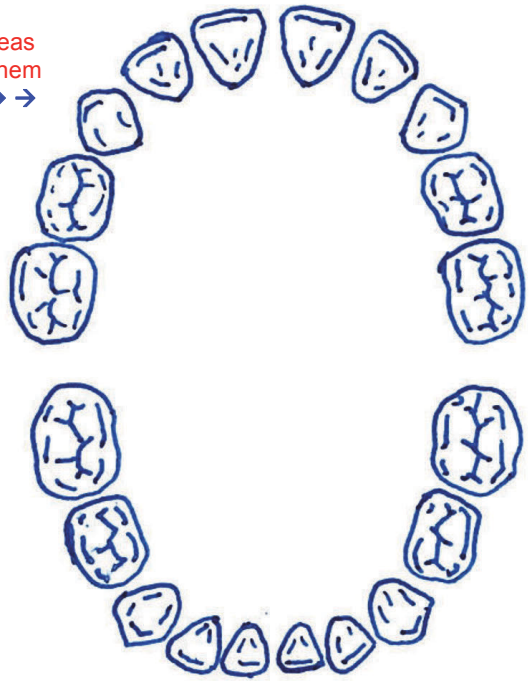
Figure 2 Tooth brushing system and technique for children (COI Plus).

Tooth Brushing System and technique for Kids - C O I Plus

Chewing surface – Outside – Inside – re-brushing

➢ Please treat the marked areas with special attention, clean them carefully and effectively! →→



We recommend the use of the following articles*

O Toothbrush	(e.g …. ……)
- training toothbrush	(e.g. ……)
- for Babys	(e.g. ……)
- for small children	(e.g. ……)
- for preschool children	(e.g. ……)
O electric toothbrush	(e.g. ……)
O Dental floss for children	(e.g. ……)
O Children's toothpaste	(e.g. ……)
O fluoride gel	(e.g. ……)
O Chlorhexidine rinse solution	(e.g. ……)
O plaque disclosing Tablets	(e.g. ……)
O Mouth healing ointment	(e.g. ……)
O Others	(…… ……)

*All these items can be purchased in drugstores and / or pharmacies.

Kindly yours

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this step makes it easier for patients with very viscous saliva or dry mouth to brush their teeth afterwards.

In the **first step**, the patient spreads fluoride-containing toothpaste (fluoride content approx. 1450 ppm) on the chewing surfaces. These surfaces are cleaned simultaneously, as scrubbing (short back and forth movement) is explicitly permitted. The amount of toothpaste applied should be "pea-sized" (equivalent to at least 1 g toothpaste) [16]. The chewing surfaces are brushed before the inside surfaces because patients find it easier to begin brushing with the chewing surfaces, on the one hand, while on the other hand, the toothpaste at the same time gets distributed in the mouth as the chewing surfaces are brushed. Moreover, it has been shown that techniques and behaviors learned in childhood are often carried over into adult life according to the field of behavioral science [22]. Thus, a health-related behavioral change is difficult to achieve in adults [1]. Children are taught the "COI system" (brushing sequence: first chewing, followed by the outside and inside surfaces) at an early age, which likewise begins with the brushing of the chewing surfaces; this is why it is perhaps easier for adult patients to implement the system recommended here later in life.

In the **second step**, the brushing of the tooth inside surfaces is performed. The "basic rule" is to brush "from red to white". The patient performs brushing posteriorly either using vibratory (analogous to the "modified Bass Technique") or small circular movements (analogous to the "Fones technique"). However the "Bass Technique" is difficult for patients to learn, and not every toothbrush is suitable for the application of this technique, we recommend the use of small circular movements for our patients. In the area of the anterior teeth, the head of the brush is held vertically and a wiping and small circular movement (short back and forth movement) is performed. Both other studies [17] as well as our own observations [8, 9] have shown that the oral areas of the mandibular posterior teeth are especially neglected. Thus, in the lower jaw, patients should begin by brushing the inside surfaces of teeth from the last tooth on one side and then continue systematically, tooth by tooth, until they reach the last tooth on the opposite side. Afterwards, the inside surfaces of the upper jaw are brushed in a similar manner. In order to achieve the best possible result, an individualized, observation-based oral hygiene consultation should take place beforehand. By doing this, dental professionals can track patients' dental and oral hygiene using their own oral hygiene products. "Problematic areas" can in this process be identified and the patients can thereby be individually informed, motivated and instructed accordingly (iIMI).

In the **third step**, the outside surfaces are brushed. The basic rule "from red to white" applies here as well. The patient can either brush the tooth surfaces using vibratory motion based on the "modified Bass Technique" or use small circular movements based on the "Fones Technique". Here too, small circular movements are preferred. The patient

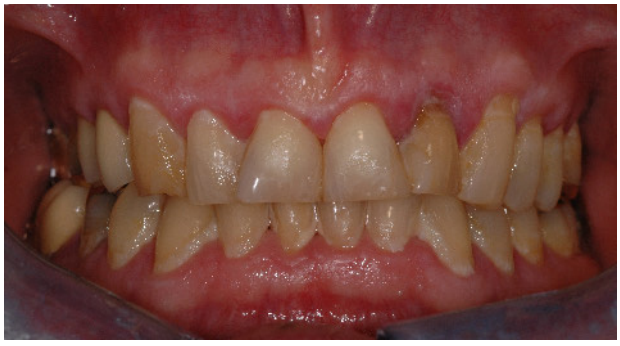

Figure 3a 63-year-old patient – 6 weeks after a supportive periodontitis therapy (SPT) – before visualization of the plaque

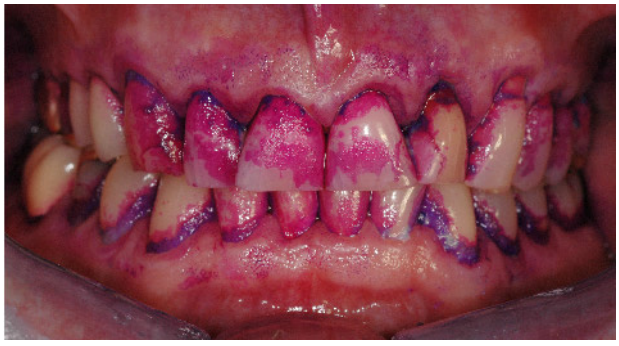

Figure 3b View after plaque staining (Mira-2-Ton, Hager & Werken, D-Duisburg) (t0: QHI = 3.32 and API = 100 %).

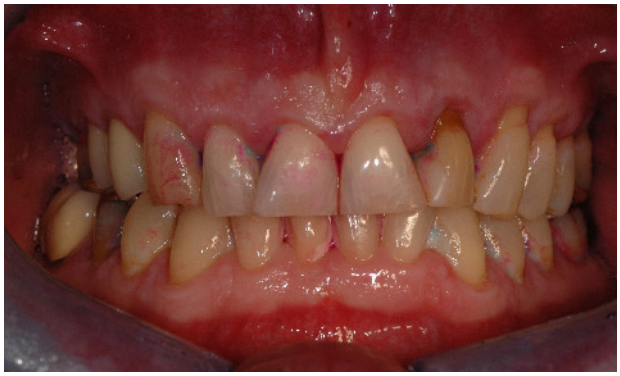

Figure 3c View after tooth brushing using CIOTI with a manual toothbrush without staining the plaque again.

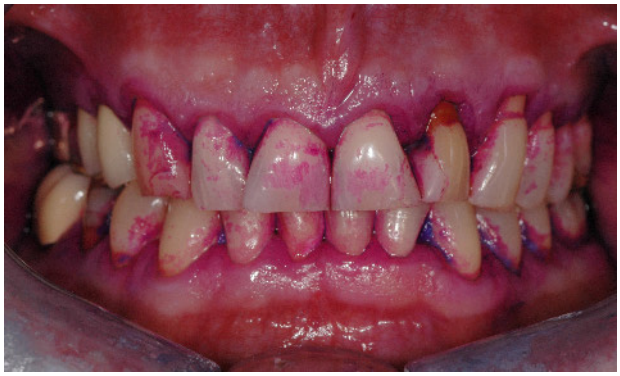

Figure 3d View after brushing using CIOTI with a manual toothbrush and plaque re-staining (t01: QHI = 2.89 and API = 100 %).

63 year old patient	QHI-all	API% (mAPI)	UJ-vest	UJ-pal	LJ-vest	LJ-ling
t0	3.32	**100**	4.07	2.21	3.36	3.64
t01	2.89	**100**	3.07	2.07	3.14	3.28
t02	1.46	**86.54**	0.17	1.43	1.28	2.43
t1 after 10 days	1.02	**78.85**	0.71	1.57	0.50	1.28
t2 after 3 months	1.39	**90.38**	1.07	1.57	1.07	1.39
t3 after 6 months	1.35	**80.76**	0.71	1.42	1.43	1.71
t4 after 12 months	1.57	**90.40**	0.71	1.57	1.71	2.28
t5 after 18 months	1.08	**82.69**	0.35	0.43	1.64	1.93
t6 after 24 months	1.14	**56.25 (1.54)**	0.14	1.28	1.14	2.00
t7 after 30 months	1.28	**60.42 (1.77)**	0.07	1.43	1.21	2.42
t8 after 36 months	1.12	**52.08 (1.62)**	0.00	0.71	0.93	2.21

Table 1 Oral hygiene status (OHY) over 3 years: OHY was performed from t0 to t4 with a manual toothbrush, then with an electric toothbrush. Average QHI and API (mAPI = mod QH-API) at times t0, t01 and t02, and reduction of plaque index values at times t1–t8.
(Tab. 1: H. Günay and K. Meyer-Wübbold)

should begin to brush from the last tooth on one side of the lower jaw and then continue systematically, tooth by tooth, until the last tooth on the opposite side of the jaw is reached. Following this, the teeth of the upper jaw are brushed in the same manner.

After the smooth surfaces have been brushed, the tongue is cleaned in the **fourth step**. Depending on the amount of plaque and nature of the tongue surface, the patient can either use a special tongue cleaner/scraper or the same toothbrush. At least two (forward and backward) pulling strokes from dorsally to ventrally along the median sulcus and the lateral borders of the tongue can be employed to clean the tongue with a cleaner/scraper. With a toothbrush, the tongue can be brushed using three circular movements at the same area of tongue.

In the **fifth step**, interdental cleaning takes place at the end after the smooth surfaces and tongue have been cleaned. It should be clear to the patient that the cleaning of the interdental spaces must be carried out separately from brushing; it requires time and concentration as well as special hygiene tools. There exist various tools for cleaning the interdental spaces such as dental floss, interdental brushes, and Soft-Picks

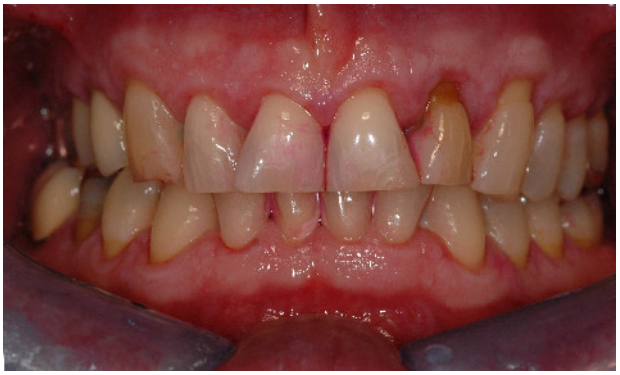

Figure 4a View after brushing the teeth (CIOTI) and step "Plus" with a hand brush without re-staining the plaque.

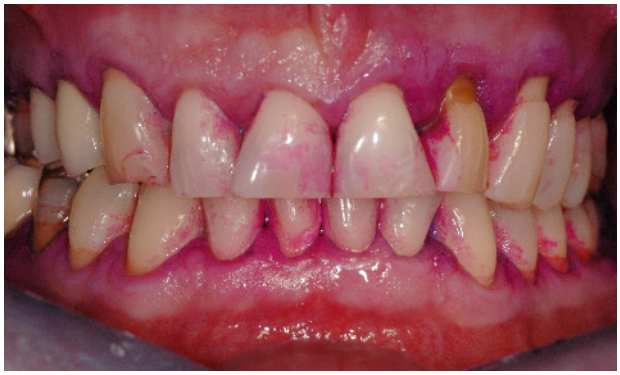

Figure 4b View after brushing (CIOTI) and step "plus" with a manual toothbrush and re-staining the plaque (t02: QHI = 1.46 and API = 86.54 %).

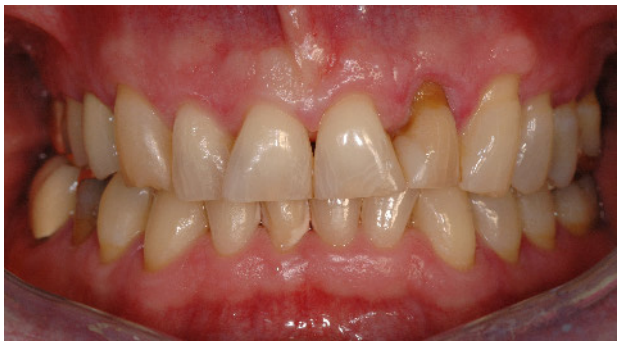

Figure 5a Control after 10 days (t1: QHI = 1.02 and API = 78.85 %)

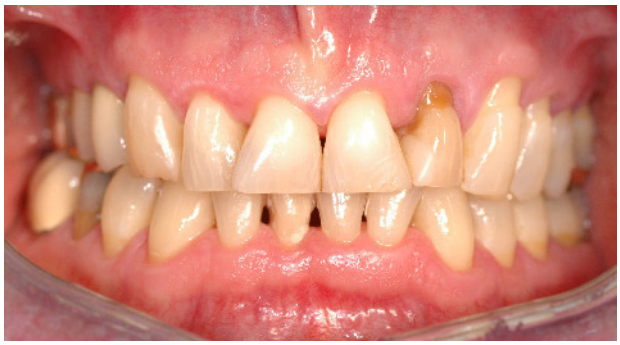

Figure 5b Control at 6 months before the SPT session (t3: QHI = 1.35 and API = 80.76 %).

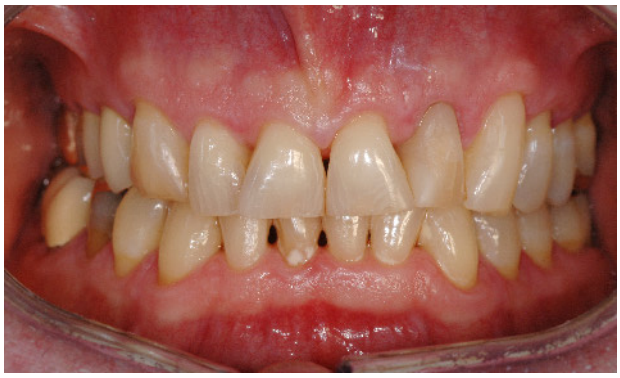

Figure 5c Control after 12 months before the SPT session (t4: QHI = 1.57 and API = 90.40 %).

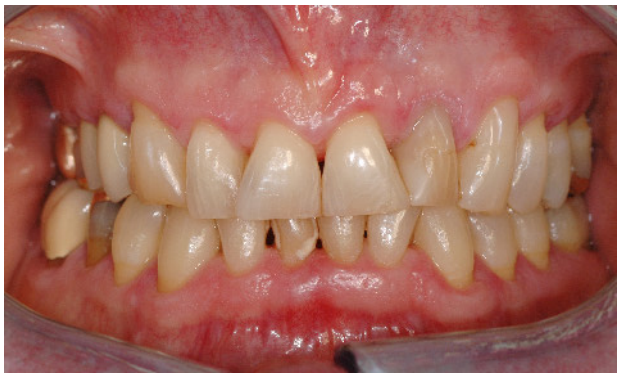

Figure 5d Control at 36 months prior to the UPT meeting (t8: QHI = 1.12 and API = 52.08 %).

(Fig. 1–5: H. Günay and K. Meyer-Wübbold)

for example. Not every hygiene tool is suitable for all of the interdental spaces. Within a dentition, interdental spaces vary in terms of width and shape. This implies that for an effective cleaning of the interdental spaces to take place, hygiene tools should be individually selected; consideration should not only be given to shape and size of the proximal spaces and the periodontal state, but also to user skill and acceptance. The recommended interdental tools should be demonstrated by dental professionals for proper use. For example, both approximal surfaces should be cleaned with two up and down movements using dental floss. The floss should be then removed as a loop out of the approximal space. When the interdental brushes and soft picks should be employed, after their insertion into the approximal space, each approximal surface should be cleaned using two horizontal brushing movements (according to the "X-Technique").

In a recent study, it was found that the cleaning of interdental spaces with dental floss before smooth surface brushing leads to more plaque reduction and fluoride concentration in the interdental spaces than when interdental cleaning was performed after the brushing of smooth surfaces [14]. Nevertheless, this aspect plays a rather minor role in the system described here. This is because another step ensues after the cleaning of the interdental spaces, whereby fluoridated toothpaste is once again applied, thus leading to a similar effect.

In the **sixth and last step** (usually in the evenings), in order to enhance the effect of fluoride and cleaning, the patient should again apply in circular/rotating movements a same amount (pea-sized) of fluoride-containing toothpaste evenly systematically (CIO) on all tooth surfaces using a toothbrush (about 1 minute). By applying fluoride-containing toothpaste once again, additional fluoride is supplied to teeth and the tooth surfaces are mechanically cleaned again. After this procedure, by taking a sip of water, the patient should dilute the toothpaste-saliva mixture (foam) in order to distribute this mixture throughout the mouth for 30 seconds, especially interdentally, and then spit it out.

"COIPlus System" for children – What does the "plus" mean here?

Analogous to the system described above for adults, we recommend the "COIPlus System" for children (Fig. 2). Firstly, the fluoridated toothpaste (fluoride content depends on the age of the child) is applied on the **c**hewing surfaces, whereby "scrubbing" is allowed in order to distribute the toothpaste in the oral cavity and at the same time to brush the chewing surfaces. The amount of toothpaste varies depending on the age of the child (e.g., rice grain, lentil, or pea size). Afterwards, the outside surfaces of the teeth are brushed; the child paints "circles on the **o**utside surfaces", corresponding to the "Fones technique". Subsequently, the tooth **i**nside surfaces are brushed with a wiping movement. "**Plus**" means

that the parents make sure that the teeth are properly cleaned and rebrush the gums and teeth (chewing/outside/inside surfaces) with rotating movements and an age-appropriate amount of fluoridated toothpaste.

The goals of the "CIOTIPlus" and "COIPlus" systems are a more effective plaque reduction as well as improved fluoride supply to the tooth surface. The effectiveness of the CIOTIPlus system has already been proven in studies [7, 8]. Increased plaque removal on smooth and proximal surfaces in older patients with periodontally rehabilitated dentitions was attained using the CIOTIPlus system [8, 9]. Furthermore, in a long-term investigation on older patients it could be shown that root surface and crown margin caries formation could be minimized and periodontal conditions could be stabilized or improved through the use of this system in combination with efficient follow-up care after periodontal therapy [7]. The effectiveness of the CIOTIPlus system is shown in Figures 3 to 5 and Table 1 in relation to a patient's case.

Conclusion

A significantly improved plaque control/reduction is achieved using the described systems "CIOTIPlus" and "COIPlus." Yet, in order to recognize "problem areas" related to plaque control, and thus be able to successfully prevent caries and periodontal disease, it is absolutely necessary that each patient receives an initial individualized and observation-oriented dental and oral hygiene advice, together with information and instructions, as well as regular follow-up instructions and motivation.

Implementing a rigid time schedule for dental and oral hygiene is counterproductive. The generally recommended 2 minutes needed to carry out sufficient dental and oral hygiene is in most cases inadequate. Especially for patients with complete as well as those with periodontally compromised dentitions and extensive prosthetic restorations or other difficult dental situations (for example, crowding, fixed orthodontic appliances) more time is required. Rather than timing how long brushing should take place, we recommend that our patients perform oral and dental hygiene until all teeth, tooth surfaces, and tongue have been cleaned. Only in step 6 (plus), we advise our patients to brush for no longer than a minute. Moreover, we recommend that patients perform dental and oral hygiene twice daily. Since many patients are often under time pressure in the morning, dental and oral hygiene according to the system described above should be carried out particularly in the evening.

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(Photos: Hannover Medical School)

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