Biodegradable polyurethane for closure of oroantral communications
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Chapter 7

General discussion
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The research in this thesis focused on the treatment of oroantral communications (OACs) and the development of a new, non-surgical treatment method of OACs with a highly porous biodegradable polyurethane foam. In Chapter 2 it was demonstrated that conventional surgery for closure of OACs still remains the golden standard, despite the numerous alternative techniques that have been presented throughout the years. It can be questioned whether there is a need for a new treatment technique for closure of OACs in the first place, as the surgical treatment methods are successful in terms of permanent closure of the perforation. However, surgical closure of OACs does have its drawbacks, and therefore research into a non-surgical method of closure is worthwhile. In the current era of implantology an alternative treatment should not interfere with buccal sulcus depth and should leave the attached gingival in place as much as possible. In addition, a non-surgical method should give predictable results, and should be easy and quick to perform. These requirements would make it possible for a general dentist to treat an OAC, which is also interesting from a socio-economical point of view.

To determine how successful a new technique should be in terms of recurrences, literature did not provide enough information. A retrospective study (Chapter 3) was therefore implemented and demonstrated that on average 1 out of 10 OACs recur after surgical closure, taking in mind that surgery was performed by either residents or maxillofacial surgeons. As with all retrospective studies, not all data that might have been contributory could be retrieved. The method of OAC repair for example was not explicitly documented in all cases.

A new treatment strategy involving biodegradable polyurethane foam

The research in this thesis focused on the use of fully synthetic polyurethane (PU) foam for closure of oroantral communications. Before this PU foam could be used in clinical trials animal experiments were implemented. The OACs that were created in rabbits (Chapter 4) all healed uneventfully.

In the traditional light-microscopic evaluation of the animal experiments the PU foam. It is therefore impossible to narrow the indication criteria for its use. Disappointingly, no factors could be pointed out that predicted a recurrence after closure with PU foam. To be precise, the sizes of the OACs differed among the recurrences, the durations of the OACs that recurred ranged from immediate closure to 4 years. This made it difficult to point out the PU remnants after such a long period of degradation. Structures, that were not recognizable as cellular structures with the electron microscope, were indicated as PU remnants. As they were repeatedly found in the different samples and were lacking in the surgically closed defects it is very likely that several stages of PU degradation were observed. It is, however, "circumstantial evi-
Can this new strategy for OAC repair involving PU foam perhaps be further optimized to gain a better treatment outcome? This is probably not the case. The clinical application protocol was already optimized as stated earlier. Also, the biocompatibility of the PU or its handling does not seem to be the problem. It was already concluded that narrowing of the indication for usage is not possible with the current data.

The mechanism behind the failures is probably the following: soft tissue healing takes place uncomplicatedly at first but due to the contamination of the PU foam, an inflammatory process sets in beneath the restored mucosal tissue and finally it "bursts" resulting in a fistula. Coverage of the PU foam with another antimicrobial medium, like for example Peripac® wound dressing, was considered. However, it would be very difficult to create an adequate level of sealing that prevents infection of the PU foam with oral bacterial flora. The only way to prevent infection of the PU foam with the subsequent risk of a recurrence seems mucosal coverage. The latter implies the need for a buccal or palatal flap to be raised and then this new treatment strategy simply offers no advantages to standard surgical closure.

Future perspectives

Alternative applications of PU foam
The animal experiments and clinical trials in this thesis showed that PU foam is a tissue friendly and safe material. Currently, fully synthetic PU foam is already being used on a large scale as a nasal dressing after nasal interventions (NASPORE®) and as a dressing after ear surgery (OTOPORE®). In these applications the PU foam absorbs fluids, provides pressure to prevent undesired adhesions and supports the surrounding tissue. Other surgical areas using biodegradable PU foam include peripheral nerve repair and colorectal surgery. Also, the use of PU foam as a topical haemostatic agent is being studied (3-5).

New and promising treatment strategies of OACs
A new method for treatment of OACs that is also usable in general dental practice would benefit both patients and health costs. The challenge for OAC closure seems to be the search for a material that provides a balance between an adequate seal to prevent antimicrobial invasion of the OAC, and at the same time providing space for bone to regenerate across the defect. The latter is important nowadays because of the demand for implant rehabilitation. At this moment in time such a product does not seem to be available although the research by Wes and co-authors (6) seems the most promising. The authors used a folded bioresorbable Biogide® membrane to close OACs. The Biogide® membrane was secondly covered by Peripac® periodontal wound dressing which was secured by sutures when necessary. It remains an interesting and difficult question to what extent the Peripac® wound dressing contributed to the successful treatment outcome in this study. Perhaps a Peripac® wound dressing alone, secured with sutures, could be sufficient for OAC repair. Although the Peripac® might solve the problem of infection, the issue of the size and shape of the defect remains. It is hardly imaginable that Biogide® can be used to close the larger and shallower OACs. Further research by Wes and co-authors seems desirable.

Also, the initial experience of an absorbable polyglactin/polydioxanon implant (Ethisorb®) for closure of OACs seemed encouraging for selected cases as studied by Buric and co-authors (7). They don’t describe any failures due to infection or extrusion of the biomaterial out of the socket. Their treatment protocol is comparable to the closure with PU foam. As this study is also performed with a foamy biomaterial one might expect that adjustments to the PU foam may lead to better results in future experiments.

In this perspective alteration of the chain length of the urethane moieties, may be considered. The tested polymer was composed of 5 urethane moieties whereas a length of 3 urethane moieties might lead to other mechanical properties and other behaviour of the foam. Future research will have to show if these possible changes in the hard segments can increase the rate of degradation while maintaining the mechanical properties of the foam during the healing period of the OAC. Still, the expectations of the use of the three-block PU should not be too high in view of the possible explanations for the recurrent OACs in the clinical studies. A three-block PU will also be contaminated in the oral environment and this may cause the same clinical problems in the healing phase of the OAC.

It is important to note that Buric et al used standard antibiotic therapy in all patients. In the current era careful prescription of antibiotics is a delicate subject. It is not likely that the current surgical treatment (not requiring antibiotic profylaxis) will be replaced by a non-surgical method in combination with standard use of antibiotics. In addition, it seems that sockets with rather favorable dimensions were treated in the Buric study. That means that, even with adjustments to the PU, it is not likely that non-surgical closure can replace surgical treatment of all types and sizes of OACs.

It can be concluded that surgical closure of OACs still is the golden standard, and perhaps will remain in at least the near future. However it is also known that some OACs heal spontaneously or with only a tight suture across the alveolus.

One very important and difficult aspect in the choice between surgical and nonsurgical treatment is the size of the OAC. Besides this, the ratio between the depth and the width of the alveolus and its perforation to the sinus probably plays a role in the healing. If the coagulum is situated in a shallower and wide alveolus spontaneous healing will probably not take place. It is challenging to measure the size of the OAC clinically. The size can be estimated by using metal probes with different diameters (7). However, exact determination is desirable as it will influence the choice of treatment. Better measurement of the size of the OAC with for example cone beam CT or the use of an impression paste might result in a more accurate and less invasive selection.
therapies. If we can predict which OACs can be left untreated or can be treated with a single suture patients will not get a surgical treatment unnecessarily in future.

Reference List


