Surgeons appreciate good handling properties, such as malleability of plates at room temperature and avoidance of bone tapping. Jain et al stated that contouring resorbable plates is easier than metallic plates. With few extra tools (ie, heating bath) resorbable plate systems could be easily handled and adapted. However, biodegradable screws can be inserted only after predrilling and pretapping. Unlike titanium screws, which can be inserted directly after drilling a pilot hole (self-tapping screw) or even without drilling a pilot hole (self-drilling screw). Biodegradable plate bending and screw insertion are time-consuming and still far more complicated compared to titanium plates.

5 Present situation

More than ten different biodegradable osteosynthesis systems are commercially available today. All are copolymers still based on PLLA. Despite the supposed advantages of biodegradable osteofixation devices, these systems have not yet replaced titanium systems and are currently applied in only limited numbers. The intrinsic mechanical properties of biodegradable osteofixation systems are still less favorable than the intrinsic mechanical properties of titanium. Application is therefore especially recommended for the stabilization of sections of the face that are not excessively loaded (midface and cranium).

Also, biodegradable systems are much more accepted nowadays in orthognathic and craniofacial surgery than in traumatology. This is probably due to the contaminated, atypical, frequently comminuted fractures in traumatology and the clean, simple, and predictable osteotomy lines in orthognathic and craniofacial surgery.

The time-consuming acts of pretapping, screw insertion, and possible screw breakage can be avoided by using the relatively new technique of SonicWeld®. The application of this osteosynthesis system is based on two components: the already well-established resorbable plate and mesh system, ResorbX®, in combination with a new special configured pin system, SonicWeld®. The pin (which replaces the screw known from other systems) is inserted by means of an ultrasonic handpiece. Due to the ultrasound application, the pin is welded into the corticospongy microstructure of the bone and melts together with the plate. The combination of plate-pin provides a more stable complex than can be accomplished by the combination of plate and screws. The thermal stress caused by the ultrasound-aided pin insertion does not lead to a foreign body reaction or induced necrosis.

The major drawback to the general use of biodegradable devices is the lack of clinical evidence that they dissolve completely without complications or remnants while biomechanically performing similar to titanium implants.

6 Future perspectives

6.1 From clinical demand to implant

The complete process of the development of a new biodegradable osteosynthesis system can easily take 15 years. First, a surgeon identifies a clinical demand or need. A technologist and material scientist develops the material and prototype. This material has to be evaluated in a laboratory, for example, by a biologist and a material scientist for toxicity. Thereafter, animal studies have to be performed by a surgeon and a cell biologist. An industrial designer will take care of the manufacturing, sterilization, and packaging. Finally, the surgeon can clinically evaluate the product.

6.2 Future aims

Some aims for future research can be formulated. The potential mechanical properties are still untapped, and stronger and stiffer biodegradable plates and screws could be developed. With a stronger material the dimensions could be reduced to microplate dimensions which would generate more indications. The degradation mechanism is not yet fully understood and more research on this topic could enhance the safety of using biodegradable implants, especially in children. Adverse reactions could be observed in more detail. New sterilization methods that do not cause degradation should be a big advantage in the practical use of the materials.

Besides these aims for further research on the existing materials, new materials could be developed for osteosynthesis.

There is also an urgent need for sufficiently powered, high-quality, and appropriately reported randomized controlled trials with respect to biodegradable osteofixation devices vs nondegradable osteofixation devices for well-defined maxillofacial fractures and osteotomies. Future studies should include a cost-effectiveness analysis in which hospital admission costs, surgical costs (material and operating room time), and the costs associated with sick leave of the patients should be analyzed.

7 Conclusion

Despite extensive study for more than 40 years, biodegradable materials have not replaced metallic osteosynthesis devices except for some limited indications. Current and future research will have to solve problems like limited mechanical properties, appropriate degradation, biocompatibility, sterilization, shelf life, and comfortable handling before biodegradable devices will be as safe and effective as metallic ones.

The socioeconomic and psychological advantages of resorbable osteosyntheses over metallic ones make it valuable to develop them. Considering the intrinsic properties of polymers, it is questionable if biodegradable polymeric osteosyntheses will ever fully banish metallic osteosyntheses from the market.