

Reconstruction accuracy of four different angular-stable mandibular reconstruction plate systems. Results of an in-vitro study.

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Objectives:

For mandibular reconstruction after continuity resection most centers use angular-stable reconstruction plates today. However, a multiplicity of plate systems are available on the market which differ concerning to their angular-stable connection between screw head and plate. The aim of the present study was the investigation of reconstruction accuracy of four widely-used angular-stable mandibular reconstruction plate systems by evaluation of the postoperative change of the position of the mandibular rami and the condyles in comparison to the original position before mandibular continuity resection.

Methods:

Following osteosynthesis systems were compared (Fig.1):

- (1) Medartis Modus Reco 2.5 (Medartis®, Basel, Schweiz)
- (2) Synthes Compact 2.4 UniLock (DePuy Synthes®, Zuchwil, Schweiz)
- (3) Synthes MatrixMANDIBLE Recon 2.4 (DePuy Synthes®, Zuchwil, Schweiz)
- (4) Stryker Leibinger Universal Mandible Recon (Stryker®, Kalamazoo, USA)

Per system 10 mandibular models (Phacon®, Leipzig, Germany) were provided. At these models (n= 40) four landmarks were marked with mini-screws on each side of the condyles und mandibular rami (A, B, C, D respectively A', B', C', D') as reproducible measuring points (Fig.2).

- A respectively A' = outermost points of the condyles
- B respectively B' = innermost points of the condyles
- C respectively C' = points at the mandibular lingula above the entry of the mandibular nerve
- D respectively D' = points at the medio-caudal side of the mandibular angle

After bending the plate along the outer outline of the mandibular model from paramedian right to subcondylar left, the plate was fixed on the model with two locking-screws at each end of the plate (Fig.3). As next step the plate was removed from the model and the mandible was resected. After resection the plate was refixed on the model in accordance to the primary drilled screw holes (Fig.4).

For evaluation of reconstruction accuracy distance measurements (M) between the four corresponding landmarks were performed with an electronic gauge before (M1) and after (M2) the reconstruction. Out of $M1 - M2 = Mx$ the change of the position respectively the deviation of the four corresponding landmarks was calculated to suggest the reconstruction accuracy of the four different systems. For this the absolute values as well as the signed values were compared.

Results:

With regard to all four measuring points together, the absolute value of Medartis Modus Reco 2.5 showed with 0.78 mm the largest median deviation from the initial value. The other systems showed nearly identical median deviations (Synthes Compact 2.4 UniLock = 0.57 mm, Synthes MatrixMANDIBLE Recon 2.4 = 0.48 mm, Stryker Leibinger Universal Mandible Recon = 0.52 mm) (Fig.5A). The difference between Medartis Modus Reco 2.5 and the three other systems is significant. In between the other systems there are no significant differences (Tab.1).

Looking at the signed values, Synthes Compact 2.4 UniLock showed a reduction of the distance between the measuring points of median -0.57 mm, which indicates a narrowing in between the rami and condyles. In contrast the other three systems showed an increase of the measured distances (Medartis Modus Reco 2.5 = +0.42 mm, Synthes MatrixMANDIBLE Recon 2.4 = +0.27 mm, Stryker Leibinger Universal Mandible Recon = +0.40 mm), which rather implies an enlargement in the rami- and condyle region (Abb.5B). Thereby the difference between Synthes Compact 2.4 UniLock and the other three systems is significant, whereas between those no significant differences exists (Tab.2).

Discussion and Conclusion:

The tested plate systems are showing differences concerning their reconstruction accuracy, which are getting partially statistically significant in our investigation. While the absolute values can act as an indicator for reconstruction accuracy of the different systems, the signed values are rather indicating, whether the plates were by tendency more bended on compression or more on extension along the mandibular model. The authors believe that the algebraic sign seems to be rather random and independent from the system, whereas the scatter range of the values can be interpreted as system dependent again. With median deviations below one millimeter, it can be assumed in general, that all investigated systems have high reconstruction accuracy. No relevant differences can be expected concerning the clinical outcome in between the investigated systems with a high probability.

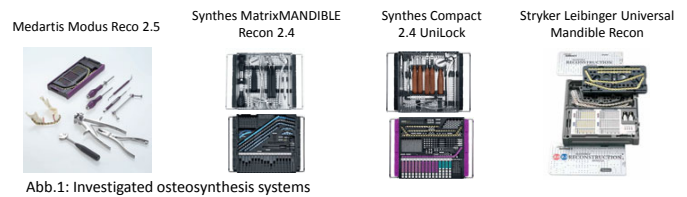


Abb.1: Investigated osteosynthesis systems

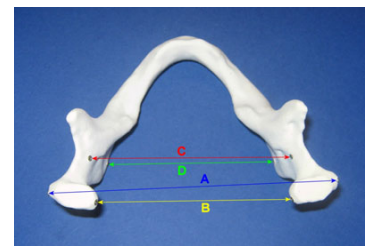


Fig.2: Measuring points



Fig.3: On the model fixated plate before resection



Fig.4: Refixation of the plate after resection

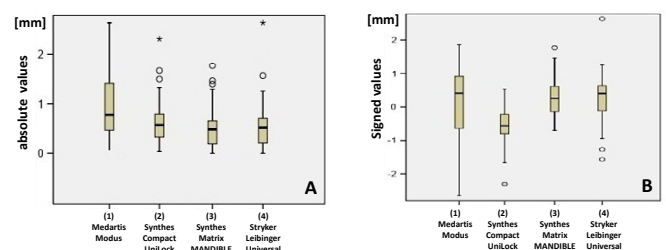


Fig.5: Median deviation of all four measuring points from the initial value after reconstruction according to the osteosynthesis system. A = absolute values, B = signed values.

(1) vs (2): $p \leq 0,034^*$		
(1) vs (3): $p \leq 0,001^{**}$	(2) vs (3): $p \leq 0,113$	
(1) vs (4): $p \leq 0,004^{**}$	(2) vs (4): $p \leq 0,319$	(3) vs (4): $p \leq 0,446$

Tab.1: Comparison of the four different systems (1) to (4). Mann-Whitney-Test: absolute values

** high significant: $p \leq 0,005$

(1) vs (2): $p \leq 0,000^{**}$		
(1) vs (3): $p \leq 0,844$	(2) vs (3): $p \leq 0,000^{**}$	
(1) vs (4): $p \leq 0,776$	(2) vs (4): $p \leq 0,000^{**}$	(3) vs (4): $p \leq 0,795$

Tab.2: Comparison of the four different systems (1) to (4). Mann-Whitney-Test: signed values

* significant: $p \leq 0,05$