Limitations and future perspectives

The methodological techniques used in this thesis included posterior-anterior cephalograms, dental stone casts and cadavers. These conventional tools are reliable methods to assess the biomechanical effects. However, they have some limitations as well. For example, the assessment of three-dimensional effects of SARME and MMD on conventional radiographs is limited. In addition, overprojection of other structures and differences in projection angle can lower accuracy. New imaging techniques make it possible to study bony and soft tissue structures in a different way than the techniques used in this thesis. These techniques include cone-beam computer tomography and 3D stereophotograms.

The review proposed in chapter 3, showed that limited research has been performed on the effects of MMD using three-dimensional imaging techniques. The studies had low sample sizes and levels of evidence. No specific studies assessed the effects of MMD on soft tissues. As the majority of the studies were conducted with fine element models and ample studies exist on the three-dimensional effects of MMD in actual patients, further research is necessary.

When looking at MMD, emphasis must be put on the possible effects it has on the TMJ in vivo and possible widening patterns. Whilst the cadaver study, chapter 4, showed the effects of the different distractors on the TMJ, the model lacked the effects of the soft-tissue envelope. In addition, the 3D dimensional movement and adaptation of the condyles can better be assessed in vivo using CBCT[1]. Regarding the widening pattern a 3D model will be more accurate to assess the effects of different distractor types. In SARME, Nada et al. and Seeberger et al. pioneered and showed the effects of tooth- and bone-borne distractors on teeth and bone, concluding that both distractors are effective for correcting maxillary transverse discrepancies[2, 3]. Seeberger et al. added to the conclusion that bone-borne distractors induce more widening of the nasal floor and induce less tipping in the first molar region.[3]

As this thesis showed that a reliable and stable widening can be achieved with both MMD and SARME, the decision whether to choose either tooth extraction or surgical widening must, rely on other factors. These include, aesthetics, patient specific factors and preferences, cost-effectiveness. This may further increase knowledge of the dis- and advantages of SARME and MMD in the oral and maxillofacial surgery and orthodontic communities.

The effect of extraction and surgical widening is different on a soft tissue level. By widening maxilla and/or mandible the bony fundament of the soft tissue is expanded and therefore can alter facial appearance[4]. In extraction therapy teeth are removed so tissue is subtracted from the dental arches. As the dental arches support the lips, these will retract after extraction and the facial appearance is altered[5]. To what extend and how both treatment modalities affect the appearance is important as it can influence the decision for either option. Future studies should therefore focus on the esthetical effects of the treatment modalities. Another relevant factor is how patients experience their treatment.

as has been shown in the current thesis. Ideally, with a prospective randomized clinical trial, outcome measurements are determined how patients encounter surgical-assisted widening versus extractions to treat narrowness of upper and/or lower jaw.

The costs for healthcare increase and health care insurance companies are reconsidering their expenses continuously. Therefore, both orthodontists and oral and maxillofacial surgeons need to be aware that treatments have to be founded on scientific evidence-based theories to ensure treatments are to be covered by insurance companies in the future.

Although MMD and SARME are well established treatment modalities, little is known on the decision making. For example, what are the reasons one orthodontist decides to choose extraction therapy or surgical widening. In the older literature the long term stability of SARME and MMD are disputed[6]. Perhaps the recent results regarding the stability are not commonly known or accepted and therefore orthodontists and oral and maxillofacial surgeons are reluctant to indicate SARME and MMD. In addition, the decision making is increasingly influenced by the patient as they are more empowered and informed. A survey study for both patients and orthodontists could clarify the decision making more for both.

With regards to the study on complications, for future studies it would be advisable to incorporate the Clavien-Dindo classification system[7]. As it allows for more objectively compare studies and treatment modalities.

In this study measurements of shape and shape changes was mainly done by hand. Although reliable inter- and intraclass correlation coefficients were achieved, automatization would optimize the results. As not only imaging techniques evolve, analysing software does improve rapidly as well. As these new techniques emerge it would be advisable to assess the effects of SARME and MMD in an automated and objectively manner[8].

The major indications for MMD and SARME include: crowding, crossbites and black buccal corridors. In addition, widening might be indicated prior to orthognathic surgery (LeFort I osteotomy, bilateral sagittal split osteotomy or bimaxillary osteotomy). This can occur in cases whereby a discrepancy in arch width becomes evident model surgery prior to the orthognathic surgery. To overcome this problem the transversal small jaw has to be widened to such an extent that the skeletal arches are equal after the orthognathic surgery. This would attribute to more stability of the orthognathic surgery as teeth can be better aligned in the jaw and alveolar ridge. To date there is no literature on the effects of this pre-orthognathic widening on the stability of the orthognathic surgery and would be therefore of interest in future studies.

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