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Treatment of Mandibular Overjet in Children With Maxillary Retrognathism

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Title page
Treatment of mandibular overjet in children with maxillary retrognathism
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Purpose

The prevalence of Class III malocclusion is about 4.2% worldwide (1-3) and approximately 6% in the Scandinavian countries (4). It is estimated that 20% of the cases with Class III are due to maxillary retrognathism (5). Patients with Cl III may have difficulties with chewing and biting of food with their front teeth (6), muscle and joint pain (7,8), and low self-esteem due to severe deviation of the face (9,10). Therefore, many patients with Cl III due to maxillary retrognathism are offered orthodontic treatment for maxillary advancement in the mixed dentition at the age of 9-12 years (11) when it is still possible to influence the midface sutures with orthodontic treatment (12). Various orthodontic treatment approaches are offered which include bone-born or tooth-born appliances connected to a face mask (11,13) or surgically inserted mandibular mento-plates in combination with Class III elastics (13). Furthermore, in some clinics, orthodontic treatment is postponed until growth has ceased, after which extraction treatment or orthognathic surgery may be offered (11,14,15). Even though early orthodontic treatment for maxillary advancement has been performed for many years (11), there is currently no evidence of which treatment approach is the most effective in the short and long term and of how and when Class III due to maxillary retrognathia should be treated (16).

New knowledge may contribute to identifying and predicting which patients will benefit from orthodontic treatment of Cl III due to maxillary retrognathism. This project is thus able to contribute to generating new knowledge about the effects of existing standard approaches to treatment, including gaining knowledge about whether different approaches of treatment have the expected effect and side effect. The results from this study will therefore be important both in terms of the perspective of the individual patient and socio-economically as the different approaches of treatment can be tailored the individual patient and thereby increase the effect of the orthodontic treatment of Cl III patients.

The hypotheses for the project are: a) Timing and approach for orthodontic treatment of Cl III due to maxillary retrognathia are different across national clinics and across Scandinavian countries; b) the immediate effect after treatment varies between different orthodontic treatment approaches of Cl III due to maxillary retrognathia; c) the short- and long-term effects and side effects of various orthodontic treatment approaches of Cl III due to maxillary retrognathia are different; d) timing, treatment approach, and craniofacial morphology have a significant impact on short- and long-term predictions, treatment effects, and side effects in the orthodontic treatment.

The aims of this project on treatment of young patients with Cl III due to maxillary retrognathia are to: 1) compare timing and treatment approaches for orthodontic treatment between national clinics and between two Scandinavian countries, Sweden and Denmark; 2) compare the treatment effect immediately after treatment between various orthodontic treatment approaches; 3) compare the treatment effect and side effects as well as patient perspectives in the short and long term after

treatment between different orthodontic treatment approaches; 4) analyse the significance of timing, treatment approaches, and craniofacial morphology for short- and long-term predictions, treatment effects and side effects in the orthodontic treatment.

The project is based upon a comparison of well-established treatment approaches for Cl III due to maxillary retrognathia. It will not introduce or test new treatment modalities, additional procedures or behavioural regulation in relation to normal clinical practice or the use of medical devices.

Relevance of the project

The project may contribute to identifying which treatment approaches and timing are most effective for orthodontic treatment of Cl III due to maxillary retrognathia. The results are therefore important for the choice of treatment approach and prognosis for the individual patient, and socio-economically important as treatment of Cl III in a better way may be tailored the individual patient whereby treatment effect may be optimised.

Method

The project involves a 10-year prospective longitudinal cohort multicentre study where orthodontic treatment and treatment effect is followed in children with Cl III due to maxillary retrognathia who undergo standardized orthodontic interceptive treatment. Standard clinical procedures are followed as usual at each clinic where standard diagnostic and follow up materials are taken before treatment, after treatment and follow ups after 5 and 10 years. The project will not introduce or test new treatment modalities, additional procedures or behavioural regulation in relation to normal clinical practice or new medical devices. The standard diagnostic and follow up materials in each clinic include examination of the dentition, occlusion, craniofacial morphology, and orofacial function. The analyses are based on the following standardized registration methods which are carried out on all the patients. Information from the patient record is included. No biological material is collected for the project.

General registrations:

- Height
- Weight
- General health information, including information regarding asthma, chronic bronchitis, hypertrophic tonsils and adenoid vegetations, mouth breathing, constantly runny nose, removal of tonsils and adenoid vegetations (17) (Appendix 1).
- Subjective sleep/sleepiness questionnaires: Epworth Sleepiness Scale for Children and Adolescents (18) (ESS-CHAD, Appendix 2), Berlin Questionnaire (19) (BQ, Appendix 3) and Pediatric Sleep Questionnaire (20) (PSQ, Appendix 4)

- Children's general well-being questionnaire: Strength and Difficulties Questionnaire (21, 22) (SDQ, Appendix 5)
- Children's general quality of life questionnaire: KIDSCREEN (23, 24) (Appendix 6)
- Subjective experience with Cl III treatment (25) (OHIP-14, Appendix 7)

Standard diagnostic and follow up examinations:

Dental occlusion, dentition, and craniofacial morphology:

- Dental occlusion is examined through analyses on intraoral scans which use video technology to reproduce teeth and dental arches in three dimensions (26)
- Tooth contact in the intercuspal position (ICP) is registered with a plastic strip (27)
- Dentition is examined on orthopantomogram (OP) (28)
- Craniofacial morphology is measured by lateral profile x-rays (29)

Oro-facial function:

- Standard screening (short form) based on Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) (30) (Appendix 8)

Practical execution of the project

The project will be carried out in close collaboration between the University of Copenhagen and Malmö University and governmentally funded public orthodontic clinics in Denmark and in Sweden. In Denmark, the orthodontic, interceptive treatment will take place at the School of Dentistry, University of Copenhagen, and in the municipal dental care in the Copenhagen and Funen area. In Sweden, the orthodontic, interceptive treatment will take place at Malmö School of Dentistry, Faculty of Odontology, Malmö University and the Orthodontic Specialist Clinic in Karlshamn, County of Blekinge. The specialists in orthodontics at the governmentally funded public orthodontic clinics which have accepted to participate in the study are responsible for the treatment, collection of data and the forwarding of data to the University of Copenhagen, Institute of Odontology, where Professor Liselotte Sonnesen is responsible for the data, and to Malmö University, Department of Orthodontics, where Associate Professor Mikael Sonesson is responsible for the data. The data from Sweden will be forwarded to the University of Copenhagen. Even though the prevalence of Cl III is relatively low in Scandinavian countries, the baseline sample size is considered possible to obtain within a reasonable period of 6 months by including three to four governmentally funded public clinics in Denmark and two governmentally funded public clinics in Sweden with a large flow of patients. Moreover, all software and the necessary skills to analyse the date are available at the University of Copenhagen, Institute of Odontology, Denmark, and at Malmö University, Department of Orthodontics, Sweden.

The standard registration and examinations are all taken as usual procedures in connection with the treatment at the governmentally funded public clinics. The patients will only be coming to their regular treatment appointments and their regular follow ups. All information is treated confidentially. The names and CPR numbers of the patients are deleted before the data is published, and all employees on the project are subject to a duty of confidentiality.

Statistical considerations

Power analysis and estimated number of participants

The required sample size will be determined through a priori power analysis, assuming a significance level (α) of 0.05 and a statistical power ($1-\beta$) of 0.80, assuming a two-sided test. The calculation is based on detecting a mean difference of 2.0° (S.D. 2.5°) in ANB angle between the treatment modalities (31) (tooth-borne (with and without facemask), and bone-borne (with and without mentoplates) and extraction only). Accordingly, the estimated sample size is 36 patients in each group approximately 180 patients in total, accounting for an anticipated dropout rate of 20%.

Statistical methods

Differences in timing and treatment approaches for orthodontic treatment of Cl III between national clinics and between Sweden and Denmark are tested with logistical and linear regression analyses. Differences in treatment effect, short- and long-term effects (in occlusion, craniofacial morphology, and orofacial function including sleep) between various treatment approaches are tested with logistical and linear regression analyses. The association between timing, treatment approaches, craniofacial morphology, and the treatment effect of the treatment approaches as well as any short- and long-term side effects during Cl III treatment are tested with multiple linear and logistical regression analyses.

Trial subjects

Inclusion criteria

Children enrolled in a standardized orthodontic interceptive treatment for Cl III due to maxillary retrognathia in governmentally funded public orthodontic clinics in Denmark and in Sweden. The power calculation showed that approx. 36 participants should be included in each group, approximately 180 children in total.

- Mandibular overjet due to maxillary retrognathia with indication for orthodontic treatment (Overjet </= 0 mm)
- Age 9-12 years
- Informed consent from parents/guardians

Exclusion criteria

- Mandibular overjet mainly due to mandibular prognathism with indication for orthodontic surgical treatment
- Known general and/or craniofacial syndromes/diseases
- Adenoid vegetations, hypertrophic tonsils and significantly reduced air passage through the nose (mouth breathing), which must be primarily treated
- Functional disorders in muscles and jaw joints, which must be primarily treated

The project can only be carried out by involving people who are included in the age group and condition in question, as many adults have received treatment for mandibular overjet during childhood, and therefore previous deviations in the occlusion cannot be registered. Furthermore, treatment of mandibular overjet with interceptive treatment can only be carried out on growing children. The project also has the direct prospect of being able to offer great benefits to the patient group that is included in the same age group and condition as the trial participants, by contributing to better choice of treatment and prognosis for the individual patients. Treatment may thereby be better tailored the individual patients, and the treatment effect can be optimised. Thereby the children may gain a better well-being and self-esteem and avoid a much more comprehensive orthodontic treatment in their adult life. The project involves minimal risks and inconveniences for the trial participants.

Risks, side effects, and disadvantages in the short and long term

The study only includes standard, validated and recognized registrations and treatment which are usual procedures and routines at the governmentally funded public orthodontic clinics in Denmark and in Sweden. Furthermore, all examinations and treatment are carried out under the responsibility of authorized professionals with many years of experience and expertise in their respective fields. There are no known side effects, risks or disadvantages of participating in the project, apart from the lateral profile x-ray at 10 years follow up which may not be routine at all clinics. Under this circumstance the x-ray dose from the lateral profile x-ray is <6 μSv, which corresponds to approx. 0.5% of the average natural background radiation per year. This x-ray dose is not expected to entail any significant risk of later development of stochastic damage. No risks for the patients' health or well-being are expected to arise.

Data management and information from patient records

All the registrations of the patients are protected by law on management on personal data and by the Danish Health Act (Sundhedsloven) as well as the Swedish National Board of Social Services (Socialstyrelsen). The patients are assigned a trial number and all data are pseudonymised. A list of

full names, CPR-numbers and trial numbers is kept separate from additional data. Data are archived for a minimum of 5 years after the last patient's visit. Data are kept on secure drives at the University. The project will be approved by the Danish Scientific Ethical Committee (protocol number: XXXXXX), by the Danish Data Protection Agency (journal number: SUND-XXXX-XX), by the Swedish Ethical Review Authority and will be registered with ClinicalTrials.gov prior to start-up.
The following information will be passed on from the patient dental records to the dental specialist responsible for the trial: Type of interceptive treatment, duration of the interceptive treatment, compliance during treatment, number of appointments and number of emergency appointments. Any necessary approval for this will be obtained from the data authorities. The record information will be used to verify the type, timing, and patient compliance during treatment and thereby contribute to verifying the hypothesis of the project. The information will be used for the project after consent to participate has been given. The consent gives the trial investigators direct access to obtain information in the patient's dental record which is necessary as part of the implementation of the research project.

Economics

The person behind the initiative for the project is professor, specialist in orthodontics, PhD, Dr. Odont. Liselotte Sonnesen in collaboration with Associate Professor, PhD, senior Consultant in Orthodontics Mikael Sonesson. The initiative for the scientific trial comes from the professor behind the initiative alone, who has no economic interest in the conduction of or the results from the trial. No commercial institution will influence the completion, results or decision-making regarding publication of the trial. There are no expenses for this project as all the children under the age of 22 years (Denmark) and 19 years (Sweden) already receive free orthodontic treatment when indication for treatment at the governmentally funded public orthodontic clinics. As the children will receive orthodontic treatment regardless of participation in this project, and no extra appointments are required if the children and their parents accept to participate in the project, no compensation is given for participation in the project. Furthermore, the School of Dentistry, University of Copenhagen, will cover the expenses for the fee for application of study approval from the Committee on Health Research Ethics: 5,862 DKK. The Faculty of Odontology, Malmö University will cover the expenses for the application to the Swedish Ethical Review Authority (16,000 SEK). If a PhD student is going to be enrolled in the project, the salary of 1,509,924 DKK is going to be applied for at the Danish Dental Association's Research Fund, the Danish Council for Independent Research, and the Danish Health Foundation. Both the Research Ethics Committee and the participants will be informed if funding is necessary and if so when it is obtained.

Compensation and/or other benefits for the patients

No compensation is given for participation in the project as the children will receive free orthodontic treatment regardless of participation in this project and no extra appointments are required if the children and their parents accept to participate in the project. The children's participation in the project will contribute to identifying which treatment approach and timing is most effective for orthodontic treatment of Cl III due to maxillary retrognathia. Therefore, the results are extremely important for choice of treatment and prognosis for the individual patient so that the treatment may be better tailored the individual patient and the treatment effect can be optimised. Thereby the children may get a better well-being and self-esteem and avoid a much more comprehensive orthodontic treatment in their adult life.

Recruitment of trial subjects and informed consent

Children together with their parents treated at the School of Dentistry, University of Copenhagen, and the governmentally funded public orthodontic clinics at the Copenhagen and Funen area and at the counties in south of Sweden will be given a brief introduction to the study and asked if they would like to participate in it. The child and their parents/guardians will then be invited to an oral participant information session at a time of their choice and informed of the right to bring an observer to the information session, which will be ensured by providing a printed version of the 'Rights of Subjects in a Health Science Research Project' prepared by the National Research Ethics Committee.

The oral information will be given by the specialist in orthodontics responsible for the treatment, and this will take place in an undisturbed, closed clinic at the clinic where the child is affiliated, prior to the provision of the written information. The information is thus provided by a person with good knowledge of the treatment and pedagogical knowledge for communication. There will be a reflection period of one week between the oral/written information before informed consent is obtained with signature on the consent form. Consent is thus sought after this reflection period and prior to participation in the study. The children will receive the same treatment regardless of whether they are included in the study or not.

Substitute consent is obtained from both holders of parental authority.

In case the patients wish to have any information on the trial elaborated they will be informed to contact Liselotte Sonnesen, alson@sund.ku.dk, +4535326670, Department of Odontology, University of Copenhagen or Mikael Sonesson, mikael.sonesson@mau.se, +46766334295. This information will be evident in the written information for the patients.

Publication of results

The research conducted in this project will lead to the preparation of at least 4 research articles for publication in leading national and international medical and dental journals. Moreover, the results will be presented at relevant scientific conferences, at governmental funded public orthodontic clinics, the Danish and Swedish Dental and Medical Associations and for the Danish and Swedish Health Authorities. Both positive, negative, and inconclusive results will be published.

Section for scientific ethical committee

Only well-established and acknowledged diagnostic methods and treatment approaches are used. The project is a comparison of well-established approaches for Cl III due to maxillary retrognathia. The project will not introduce or test new treatment approaches, additional procedures or behavioural regulation in relation to normal clinical practice or new medical devices. All examinations and treatment are carried out under the responsibility of authorized professionals with extensive experience and expertise in their respective fields. It is estimated that there is no risk to the health and well-being of the patients.

The results of the project can contribute to identifying which treatment approaches and timing is most effective for orthodontic treatment of Cl III due to maxillary retrognathia. The results are therefore extremely important for choice of approach and prognosis for the individual patient, and socio-economically as treatment of Cl III can be tailored the individual patient and the treatment effect can be optimised. Thereby the children may get a better well-being and self-esteem and avoid a much more comprehensive orthodontic treatment in their adult life.

Participation in the study is voluntary, and project participants participate after written, informed consent is signed by the parent/guardian. Project participants can withdraw from the study at any time without consequences for orthodontic treatment or future dental check-ups. For parents/guardians who do not want their child to participate in the study, or children who are withdrawn from the study, there will be no consequences for the child's orthodontic treatment, dental check-ups and treatment.

The project involves minimal risk and inconvenience for project participants. The trial acts in conformity with the declaration of Helsinki II.

Information about compensation

Patient insurance according to “Lov om klage- og erstatningsadgang inden for sundhedsvæsenet” [“Act on Complaints and Access to Compensation within the Healthcare System”], provided by The Danish Patient Compensation.

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This document is submitted to ClinicalTrials.gov as supporting documentation for the above-referenced clinical study.