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学 位 論 文 題 名	Changes in cross-sectional measurements of masseter, medial pterygoid muscles, ramus, condyle and occlusal force after bi-maxillary surgery (上下顎骨切り術後の咬筋、内側翼突筋、下顎枝、下顎頭、咬合力の断面測定値の変化の検討)
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学位論文内容の要旨

Purpose: The purpose of this study was to examine changes in masseter and medial pterygoid muscles, ramus, condyle and occlusal force after bi-maxillary surgery in class II and III patients.

Subjects and methods: The subjects consisted of 42 Japanese female patients (84 sides) with jaw deformities diagnosed as skeletal classes II and III, to exclude the gender difference. This was a retrospective factorial cohort study and informed consent was obtained from the patients. Conventional lateral cephalometric measurements were analyzed pre-and post-operatively, according to previous reports. All 42 patients underwent sagittal split ramus osteotomy with Le Fort I osteotomy. Twenty one class II cases were mandibular advancement and 21 class III cases were mandibular setback performed by the method reported previously. A high-speed, advantage-type CT generator (Aquilion One; Toshiba Medical Systems Corp, Tochigi, Japan) was used, similar to the method reported previously. CT measurements were performed using a similar method reported previously. The RL line was determined as the line between the most anterior points of the bilateral auricles at the plane parallel to the FH plane. Multi planner reconstruction can be established in the software such that the arbitrary plane can be moved parallel to the plane in which the RL line was determined. The horizontal plane above the mandibular foramen parallel to the FH plane was identified on the right and left sides, and the masseter and medial pterygoid muscles, and ramus were measured in each side preoperatively and at 1 year postoperative. Condyle was measured on each side in the plane parallel to FH where maximum area of the condyle was recognized (Simplant®, Materialise, Leuven, Belgium) and (Image J®, National Institutes of Health, ML, USA) the items listed below.

Results: 3.1. CT measurements In class III, ramus area ($P < 0.0001$), ramus length ($P = 0.0054$), ramus width ($P < 0.0001$), masseter length ($P = 0.0122$), med pterygoid area ($P = 0.0021$) and med pterygoid length ($P = 0.0092$) increased significantly after 1 year. In class II, the area ($P = 0.0003$) and width of the masseter muscle ($P < 0.0001$) decreased significantly, while ramus length ($P = 0.0171$), masseter length ($P = 0.0107$) and med pterygoid width ($P < 0.0001$) increased significantly after 1 year. Preoperatively, class II was significantly

larger than class III in ramus area ($P = 0.0050$), ramus width ($P = 0.0089$), masseter width ($P = 0.0068$), medial pterygoid area ($P < 0.0001$) and medial pterygoid length ($P < 0.0001$). However, class II was significantly smaller than class III in medial pterygoid width ($P < 0.0001$). After 1 year, class II was significantly smaller than class III in the length of masseter muscle ($P = 0.0017$).

Class II remained larger than class III in ramus width ($P = 0.0408$), and the square of medial pterygoid muscle after 1 year ($P = 0.0343$). In class III, condylar area ($P = 0.0181$) and masseter vertical length ($P = 0.0001$) increased significantly after 1 year. However, there was no difference in the condylar angle, thickness and width. In contrast, in class II, condylar angle ($P = 0.0369$), condylar width ($P = 0.0001$), and masseter vertical length ($P = 0.0191$) decreased significantly after 1 year. Class II was significantly larger than class III in condylar angle pre-operatively ($P < 0.0001$) and after 1 year ($P = 0.0006$), and class II was significantly smaller than class III in masseter direction angle pre-operatively ($P < 0.0001$) and after 1 year ($P = 0.0006$). After 1 year, class II was significantly smaller than class III in condylar thickness ($P = 0.0020$), condylar width ($P < 0.0001$), and condylar area ($P < 0.0001$). After 1 year, class II was significantly larger than class III in masseter vertical length ($P = 0.0005$), although there was no significant difference between classes II and III pre-operatively.

3.2. Cephalometric analysis There were significant differences between classes II and III in SNB ($P < 0.0001$), Mandibular plane angle ($P = 0.0007$), and Overjet ($P < 0.0001$), pre-operatively. There were significant differences between classes II and III in SNB post-operatively ($P = 0.0142$). **3.3. Occlusal force and contact area** There was no significant difference between pre-and post-operative values in both classes II and III. Furthermore, there was no significant difference between classes II and III preoperatively and at 1 year post-operative.

Discussion: When mechanical stress in the maxillo-facial region is calculated using a mathematical model, the force generated by the masticatory muscles, occlusal force and stress on the condyle are required in order to determine the equations. Although stress on the condyle and masticatory muscle force cannot be measured directly, occlusal force alone can be measured directly with a device. Therefore, it is very important to integrate the morphological data such as masseter and medial pterygoid muscles, ramus and condyle and the functional data such as occlusal force before and after orthognathic surgery.

Conclusion: This study suggested that changes in the cross-sectional measurements of masseter and medial pterygoid muscles and the condyle differed between class II and class III patients, although occlusal force did not significantly change 1 year after surgery in both groups.

論文審査結果の要旨

背景として、顎変形症は、後方へ変位したクラス II と、前方への変位したクラス III に分けられる。顎変形症患者は正常咬合者よりも咬合力が低いことが知られている。顎変形症に対し顎矯正手術が行われるが、クラス II に対し Le fort I 型(LI)手術が、クラス III に対し下顎枝矢状分割術(SSRO) が施行され、それぞれ前方固定および後方固定が行われる。顎矯正手術では骨格の安定性を確立することが重要であり、咀嚼力と咬合力の変化を引き起こす。咬筋および内側翼突筋からなる咀嚼筋は咀嚼機能において重要であり、咬合力と強く関連する可能性がある。手術前後の咀嚼筋形態と咬合力の関係を調査することは重要であるが、咬筋断面積や内側翼突筋の断面積と咬合力との関係を調べた研究はほとんどなく、特にクラス II 患者に対する検討はこれまで行われていなかった。そこで、高山氏は本研究において、クラス II およびクラス III に対する顎矯正手術前後の咬合筋を含む下顎骨の形態変化、および咬合力の変化を明らかにすること目的として検討を行った。

高山氏は、クラス II および III と診断され顎変形症に対し手術を行った 42 例を対象とし、後ろ向き研究を行った。CT 画像を詳細に解析し、解析項目としてこれまで検討項目である咬筋および内側翼突筋に加え、力学的負荷を考慮し下枝および下顎頭の形態変化を解析項目に加えた。さらにセファロ分析、咬合力と咬合接触面積の解析を行った。その結果、咬筋・内側翼突筋・下顎頭の断面測定値の変化は、クラス II 患者とクラス III 患者とで異なること、咬合力は両群で 1 年手術後も有意に変化しないことが示された。

本研究論文は、これまで検討されていない顎変形症クラス II の術前後の変化を明らかにするとともに、顎変形症のクラス III との違いを明確にした。顎変形症に対する手術 1 年後における下顎周囲の形態変化と咬合力の変化を初めて明らかにしたものであり、その学術的意義は認められる。

高山氏は、学位審査発表会のプレゼンテーションにおいて、顎変形症のクラスの違いによる手術アプローチの違い、術後の骨格や筋の変化と安定性の変化について分かりやすくまとめて提示した。さらに、顎矯正手術前後の画像データのその解析から得られた結果は信頼性の高いものと考えられた。結果に対し複合的な観点から解釈と考察がなされ、今後の発展性についても示され理解を深められる内容であった。審査員より、顎変形症の臨床的問題点や、研究の意義、新規性などに関し質問があったが、簡潔で明快に回答しており、本論文の発展性についても誠実に述べられいた。本論文は、今後さらに顎矯正術の意義が深く理解されることに貢献するものと考えられた。以上より、高山氏の学位論文について、学位にふさわしいものと審査員が全員一致し評価した。