様式 C-19

科学研究費補助金研究成果報告書

平成２１年６月１日現在

研究種目：基盤研究（C）
研究期間：2007～2008
課題番号：19592357
研究課題名（和文）　哺乳時の下顎の動きは前後が主体である　これは咀嚼運動においていつまで継続するか？
研究課題名（英文）　Protrusion and retrusion are dominant mandibular movements during nursing. How long do these movements continue?

研究代表者
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研究成果の概要：
歯列期の小児の咀嚼運動は、成人が側方への動きが主体であるのに対し特に前方向への運動が優位であるが、これは数多く報告がなされている哺乳時の舌の運動に伴う下顎の動きから継続していることが推察できる。またこれと関連して長期哺乳が下顎前突と関連があるとの報告もある。そこで本研究では、この小児の咀嚼運動に見られる優位な前後運動がいつ頃まで続くかを明らかにすることを目的とした。
咀嚼運動の計測を定量的におこない得る年齢はおよそ４歳以降であった。３歳以下では、個人間変動が大きいとともに、日間差、時間差、またそのときの情動変化により個人間変動が大きく変化することから、傾向はつかめるものの統計処理にふさわしい数値が必ずしも得られないと判断せざるを得なかった。４歳以降の小児を乳歯列期の小児とし、以後の変化を観察したところ６歳および１２歳に咀嚼運動経路および範囲、角度等に関して統計的な有意な差が認められた。運動は総じてより平坦な運動からより下方への運動に変化していた。この２つの時期は第一大臼歯および第二大臼歯の萌出時期であり、ともにその時期の最後臼歯である。これらのことから小児の咀嚼運動は最後臼歯の萌出により顕著に変化すると考えられた。また、この時期には顆頭の形態にも大きな変化がうかがわれること、咀嚼運動の安定性が増すなどの報告があることから、これらの知見に関しても今後検討が必要である。

交付額

（金額単位：円）

	直接経費	間接経費	合　計
２００４年度			
２００５年度			
２００６年度			
２００７年度	2,330,000	690,000	3,020,000
２００８年度	800,000	240,000	1,040,000
総　計	3,130,000	930,000	4,060,000

研究分野：医歯薬学
科研費の分科・細目：歯学・矯正・小児系歯学
キーワード：咀嚼、小児、哺乳

１．研究開始当初の背景

昨今、健康の維持増進に関心が高まっている中、特に「食」に関して注目が集まっており、行政も少子高齢化が進むことを背景に各種の施策を打ち出している。その中で 「健康日本２１」において「咀嚼機能の維持」は

達成すべき目標のひとつとして掲げられている。また、昨年７月に施行された「食育基本法」に基づき、本年 3 月 31 日には「食育推進基本計画」が示されるにいたり、平成 22 年までの５年間の計画期間に「子どもの食育」に重点をおいた具体的な方策が求められている。

２．研究の目的

哺乳に認められる下顎の前後方向が優位な運動が、咀嚼運動に変化するが、この優位な運動がいつまで継続するかを明らかにすること。

３．研究の方法

モーションキャプチャーの手法を用いて、捕食運動を解析し、目的で述べた運動様式に変化を明らかにする。また、成人と比較することにより、その特徴を検討する。

４．研究成果

咀嚼運動の計測を定量的におこない得る年齢はおよそ４歳以降であった。３歳以下では、個人間変動が大きいとともに、日間差、時間差、またそのときの情動変化により個人間変動が大きく変化することから、傾向はつかめるものの統計処理にふさわしい数値が必ずしも得られないと判断せざるを得なかった。４歳以降の小児を乳歯列期の小児とし、以後の変化を観察したところ６歳および１２歳に咀嚼運動経路および範囲、角度等に関して統計的な有意な差が認められた。運動は総じてより平坦な運動からより下方への運動に変化していた。この２つの時期は第一大臼歯および第二大臼歯の萌出時期であり、ともにその時期の最後臼歯である。これらのことから小児の咀嚼運動は最後臼歯の萌出により顕著に変化すると考えられた。

主な成果（未発表論文の要旨）

１） Title: The Investigation for the Contractive Strength of Musculus Orbicularis Oris in Preschool Children.

Summary: The aim in this study was to investigate the contractive strength of Musculus Orbicularis Oris in normal preschool children and to compare with normal adults. Subjects in preschool children were consisted of 172 (92 boys and 76 girls, mean age: 5 years and 4 months: from 3 years and 7 month to 6 years and 8 month); 3-year-old (3 boys and 7 girls), 4-year-old (27 boys and 20 girls), 5-year-old (37 boys and 28 girls) and 6-year-old (25 boys and 25 girls), and in adults were consisted of 134 (57 male and 77 female, mean age: 25 years and 4 months: from 15 years to 45 years). The contractive strength of Musculus Orbicularis Oris was measured by the button pulling. The strength in children (mean: 0.42 kgf, range: 0.05～1.02kgf) was significantly smaller than in adults (mean: 0.96kgf, range: 0.27～1.65kgf) ($p > 0.01$). The strength in children from 3 years to 6 years in this study was increasing as grow, and the significant difference between each age was found. On the other hand, the gender difference in adults was found, but was not found in preschool children.

２） Title: Occlusal Contacts around Intercuspal Position during Chewing.

Summary: Occlusal phase of chewing is interesting because food particles are being pulverized in this phase. For efficient chewing, the upper and lower teeth must come together in a congruent fashion with less variation than in other phases. The purposes of this study were 1) to test the difference of occlusal contact area (OCA) between the intercuspal position (ICP) and the minimum opening position (MOP) of chewing cycle, and 2) to quantify the OCA both the opening and closing strokes during chewing. To achieve these purposes, thirteen female volunteers were participated. A measurement system, which combined a

tracking system for mandibular movement with a three-dimensional digitizer for tooth shape, was used. As results, three-dimensional distance between the ICP and the MOP was less than 0.128 mm at lower incisal point. And also the difference of the OCA between these positions was less than 1.5% at the ICP. The OCA of all teeth during closing and opening strokes showed almost symmetrical along the motion. These results suggest that the ICP and the MOP is very close and the opening and closing strokes are well controlled.

3) Title: Head Motion May Help Mouth Opening in Children.
Summary: Concomitant head and mandibular movement during jaw function is well known in adults; however, its importance in children has not been studied. The brain attains 85% to 90% of its adult weight at 5 years of age, however. On the other hand, the maximum rate of condylar growth is attained at approximately 14 years of age (Buschang *et al.*, 1999).This study investigated head and mandibular movements of 19 children with complete primary dentition (average age: 5 years 5 months) and compared their functional integration of jaw and head movements to those of 16 female adults (average age: 20 years 3 months) with permanent dentition. Although the mandibular opening distance was significantly greater in the adults, the magnitude of concomitant head motion was greater in children. The results suggest that head extension in children helps increase the magnitude of mouth opening more than in adults.

4) Title: Mandibular open-close motion in children with anterior crossbite occlusion.
Summary: Anterior crossbite (ACB) malocclusions are frequent; however, its characteristic functional features have not been fully described. The purpose of this study was to determine the characteristics of habitual mandibular open-close motion in children with ACB of their primary dentition. Two groups of children were selected for study; 17 with ACB (8 boys and 9 girls; 4 years 1 month to 7 years 1 month) and 19 with normal occlusion (8 boys and 11 girls; 4 years 6 months to 6 years 7 months). The motion was recorded using an optoelectronic analysis system with six degrees-of-freedom. Mandibular incisor and condylar motion were analyzed by measuring their three-dimensional ranges and trajectories. Also estimated incisor and condylar pathways of the two groups were compared. Patients with ACB opened wider with more anterior-posterior condylar translation and more mandibular rotation. Although between-subject (inter-individual) variance of all variables in children with ACB was larger they had less within-subject variance at the condyles. These results indicate that open-close mandibular motion in children with ACB is completely different from that of children with normal occlusion. The different motions might be related to morphological

differences between the two groups.

5) Title: Head extension during serial mouth opening-closing motion in children. Summary: Some articles revealed concomitant mandibular and head movement during jaw function in adults. This coordination between head and mandible will be indispensable for the healthy stomatognathic function. The feeding behavior of human starts from nursing, through the weaning period, finally the masticatory patter will be developed in adults. Because both head and mandible grows with different patterns, the concomitant motions must be changing during a serial of this functional developing stage. As these aforementioned reasons, the purpose of this study was to reveal the differences of this concomitant motion between children with primary dentition and adults with permanent dentition. Nineteen children with the complete primary dentition (average age: 5 years 5 months) and 16 female adults (average age: 20 years 3 months) with permanent dentition were participated in this study. The motions of head and mandible during ten-repeated mouth opening-closing motion were measured in three-dimensionally, and that the differences of two subjects groups were tested. Our results exhibited an existing the difference of functional integration between the human jaw and head regions between above two groups. Although the mandibular mouth opening distance was significantly greater in adult compared with children, the magnitude of head motion was in reverse relation. The results might suggest that the head extended movement in children would help more to increase the magnitude of mouth opening compare with adults. Further investigation will be required to find detailed developmental processes of head-mandible integration.

５．主な発表論文等

（研究代表者、研究分担者及び連携研究者には下線）

〔雑誌論文〕（計６件）

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６．研究組織

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