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研究課題名（和文）Pre-emptive Delivery of Pain Specific Local Anaesthetic (QX-CAP) to Prevent Endodontic Postoperative Pain

研究課題名（英文）Pre-emptive Delivery of Pain Specific Local Anaesthetic (QX-CAP) to Prevent Endodontic Postoperative Pain

研究代表者

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研究成果の概要（和文）：カプサイシンと併用することにより感覚神経だけを麻酔できるQX-314を用いて、根管治療における疼痛軽減を検討した。下顎切歯を切削し歯髄を露出した後、根管治療を施したラットでは、シャムおよび未処置ラットと比較して、三叉神経脊髄路核尾側亜核（Vc）にc-Fos発現が増加していた。根管治療後、オトガイ神経支配領域にQX-CAPを注入すると、Vcにおけるc-Fos発現が減少することが確かめられた。このことは、根管治療の痛覚によるニューロン活動がQX-CAP注入によって減少することを示しており、根管治療後の疼痛軽減にQX-CAPが有効である可能性を示唆していると考えられる。

研究成果の学術的意義や社会的意義
Anaesthetizing the nerves that supply the dental pulp of a tooth using the commbination of a permanently charged sodium channel blocker (QX-314) and a TRPV1 agonist (capsaicin; QX-CAP) prior to endodontioc procedure may reduce the pain during treatment of the dental pulp like root canal treatment.

研究成果の概要（英文）：We have investigated the possibility of using the combination of a permanently charged sodium channel blocker (QX-314) and a TRPV1 agonist (capsaicin; QX-CAP) in reducing postoperative pain after endodontic treatment. We have made an animal model to mimic endodontic treatment procedure. The dental pulp of the rat`s lower central incisor was exposed using dental drill and stimulated with an endodontic file to mimic the endodontic treatment procedure. A neuronal marker, c-Fos, expression increased in the trigeminal subnucleus caudalis (Vc) following the endodontic procedure compared to that of sham and naive rats, indicating increase of neuronal activity in the Vc due to the endodontic procedure. QX-CAP injection near the mandibular and mental nerve areas reduced the number of c-Fos expressing neurons in the Vc in rats with endodontic procedure, indicating reduction of endodontic procedure-induced neuronal activation by the QX-CAP injection.

研究分野：Dentistry

キーワード：Qx-314　Capsaicin　Endodontic pain　Trigeminal nerve　c-Fos　TRPV1

１．研究開始当初の背景

Local anesthetics (LAs) are widely used for blocking pain while retaining consciousness. LAs block the generation and propagation of action potentials by blocking voltage-gated sodium channels at the intra-neuronal site. Commercially available LAs (e.g., lidocaine) have little or no selectivity to nerve fibers. Therefore, although the goal of LAs is to block pain, the administration of LAs also produces numbness due to the blocking of pressure and touch receptors, immobility due to the blocking of motor axons, and low blood pressure due to the blocking of autonomic (sympathetic) nerve fibers. For example, during dental surgery procedures, LAs may cause numbness of the lips, checks and tongue, and partial immobility of the tongue. While this may be acceptable during surgery, specific blocking of only the pain sensation would be desirable. Sensory-selective local anesthesia has long been an important goal for local anesthetic development.

In our previous research we, we found that the combination of a permanently charged sodium channel blocker QX314 and capsaicin (QX-CAP) attenuated neuropathic pain (NP) for a long period following injury to inferior alveolar nerve, a branch of trigeminal nerve (Zakir et al. PLoS One, 2012). When QX-314 combines with capsaicin (a TRPV1 activator), it opens the TRPV1 channel, allowing QX-314 to enter nociceptive neurons **(**Binshtok et al. Nature, 2007). In this study, we investigated the possibility of using the QX-CAP in reducing postoperative pain after endodontic treatment. Endodontic postoperative pain is a common problem faced by dentists in their clinical practice which showed neuropathic pain like symptoms (Nixdorf et al. J Endod. 2010). Prolong activation of pulpal nerves during endodontic procedure (like root canal treatment) may lead to central sensitization (plastic changes in second order neurons in the brainstem) responsible for occurrence of pain after endodontic procedures. Blockade of surge of neuronal activity for long time after endodontic procedures may prevent central sensitization. Long lasting QX-CAP anesthetic has the potential to block the neural surge for longer period which may reduce the central sensitization thereby may prevent/reduce the post-endodontic neuropathic like pain.

２．研究の目的

In this study, our objectives were. 1) Making an animal model to mimic endodontic treatment procedure (ETP). 2) Understanding the pattern of neuronal activation in the spinal trigeminal sub-nucleus caudalis (Vc) and associated regions by the mimicked endodontic procedure. 3. Effect of pre-emptive delivery of QX-CAP anesthetic on neuronal activation by the endodontic procedure.

３．研究の方法

The study conducted in Sprague–Dawley (SD) rats. Ethical approval of study protocol obtained from Matsumoto Dental University Animal Ethics Committee. Four groups of rats were used.

1) **Experimental Groups: Naïve group:** This group received no treatment. **Sham group:** rats received superficial drilling on enamel of the left lower central incisor without exposing the dental pulp and needle prick into the tissues near the mandibular and mental nerves. **Rats recieved ETP:** rats received repeated stimulation of the exposed dental pulp. **QX-CAP anesthetic group:** rats received QX-CAP anesthetic before ETP.

2) **QX-CAP anesthetic**: QX-314 followed by capsaicin was injected as QX-CAP anesthetic 10 min prior to starting the drilling of the tooth. 100 μl QX-314 followed by 50 μl of 0.05% capsaicin was injected in the subcutaneous connective tissue near the mandibular nerve using a syringe.

Additionally, 50 μl QX-314 followed by 25 μl of 0.05% capsaicin was injected in the subcutaneous connective tissue near the mental nerve. QX-314 [N-(2,6-dimethylphenylcarbamoylmethyl) triethylammonium bromide] (Sigma-Aldrich, USA) dissolved in normal saline. Capsaicin (Wako Pure Chemical Industries, Ltd., Japan) solution (0.05%) was prepared with ethanol, Tween 20, and normal saline.

3) **Making of an animal model:** Under general anesthesia we exposed the dental pulp of the rat`s lower central incisor using dental drill and then repeatedly stimulate the dental pulp using an endodontic file to mimic the ETP. 2 hours after the procedure, we checked whether this procedure increased the activity of neurons in Vc areas of the brainstem.

4) Immunohistochemistry: Two hours after ETP, the rat was deeply anesthetized with the same anesthesia and transcardially perfused sequentially with physiological saline followed by 4% paraformaldehyde in 0.01 M phosphate-buffered saline (PBS). The brainstem was removed and then transferred to 30% sucrose in PBS for 2 to 3 days for cryoprotection. Frozen transverse cryotome sections (50 μm) were collected on glass slides. After washing, the sections were placed in blocking solution (BLOXALL, Vector Laboratories, USA) for 30 min. They were incubated for 2 hrs. at room temperature in 5% normal goat serum (NGS) and 0.3% Triton X-100 in PBS and then incubated with an anti-c-Fos antibody (Abcam, USA; 1:25,00) diluted in 2.5% normal goat serum with 0.3% Triton X-100 in PBS for 24 hrs. Then the sections were incubated with biotinylated goat anti-rabbit-IgG (Vector Laboratories, USA) for 2 hrs at room temperature. Sections were then subjected to a peroxidase-conjugated avidin reaction (ABC Vectastain, Vector Laboratories, USA), and reaction products were visualized with a diaminobenzidine (DAB) substrate kit (ImmPACT DAB EqV, Vector Laboratories, USA). All sections were dehydrated in an alcohol series, cleared in xylene, and cover-slipped with synthetic mountant (Vector Laboratories, USA). Images were acquired by light microscopy, with a CCD camera attached to the microscope (Olympus, Japan). Transverse sections of the brainstem (-1.6 mm to 0.5 mm from obex) (Paxinos and Watson, 2007) were immunostained for c-Fos and examined bilaterally.

４．研究成果

1) **Animal model prepared to mimic ETP successfully activate brainstem neurons**

The animal model that we prepared to mimic ETP, successfully activate neurons in the trigeminal sub-nucleus caudalis (Vc) and associated nucleus tractus solitarius (NTS) areas. In the Vc, activated neurons were mainly observed in the dorso-medial regions (Figure 1). In the NTS, activated neurons were mainly observed in the medial NTS regions.

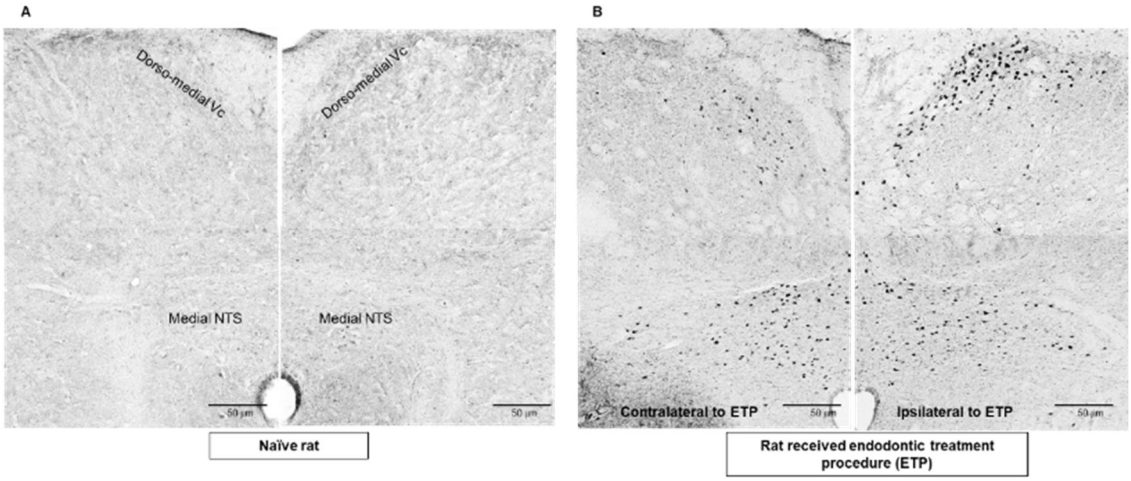

Figure 1. (A) Sections showing Vc and associated areas taken from naïve rats (rats that received no treatment). The number of neurons expressing c-Fos were very few. (B) Sections showing Vc and associated areas taken from rats that received endodontic treatment (ETP). A large number of neurons were activated by ETP (indicated by c-Fos expressions) in the Vc and NTS regions. Neurons were activated bilaterally, although, more neurons were activated ipsilateral to ETP specially in Vc areas compared to that of contralateral to ETP.

2) Pattern of neuronal activation and effect of prior local application of QX-CAP anesthetic near the nerves

A. Vc regions

c-Fos expressing neurons were very few in the Vc of the naïve rats. In sham operated rats the number increased bilaterally but it was not significantly different than naïve rats (Figure 2). In the rats that received ETP, the number of c-Fos expressing neurons significantly increased bilaterally compared to naïve and sham operated rats (Figure 2). The number of c-Fos expressing neurons was more in ipsilateral side of the ETP compared to that of contralateral side, although the difference was not statistically significant. Prior application of QX-CAP anesthetic near the mandibular and mental nerve areas significantly reduced the number of c-Fos expressing neurons in the Vc, ipsilaterally (Figure 2). In the contralateral side, although QX-CAP anesthetic reduced the number of ETP-induced c-Fos expressing neurons, it was not statistically significant. The significant reduction of c-Fos expressing neurons in the Vc by prior application of QX-CAP anesthetic indicates that QX-CAP anesthetic can reduce ETP-induced neuronal activation in the Vc ipsilaterally (Figure 2).

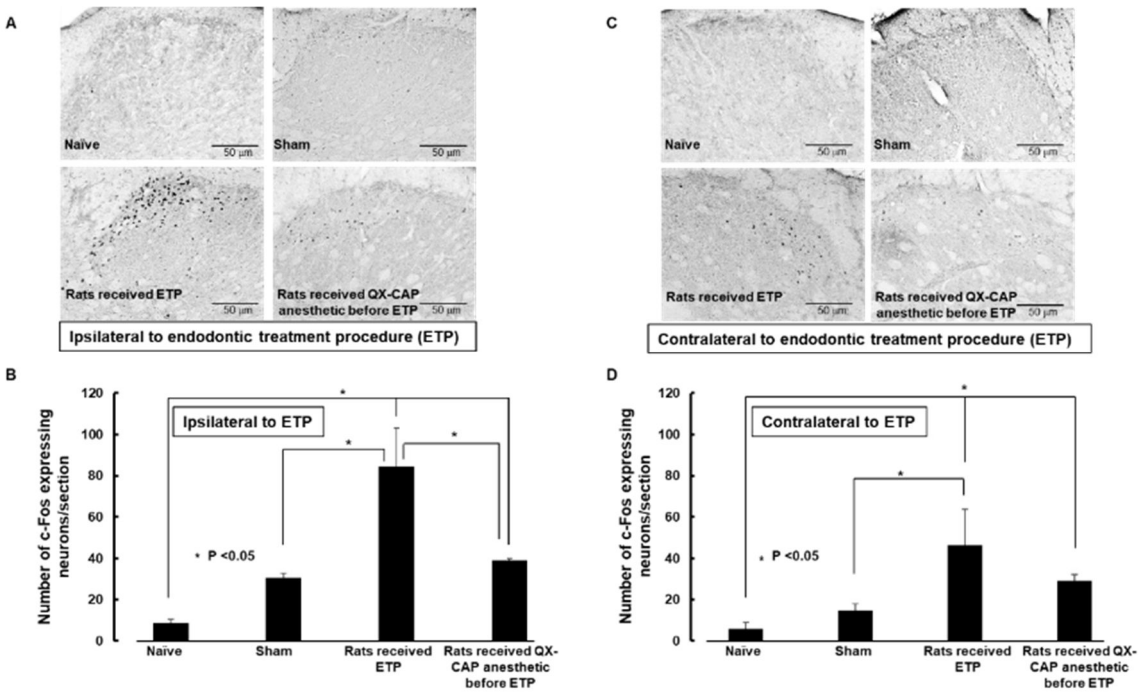

Figure 2. (A) Sections showing Vc regions taken from different rat groups ipsilateral to ETP. (B) Bar graph shows the average number of c-Fos expressing neurons per section ipsilateral to ETP for different rat groups. The number of c-Fos expressing neurons significantly ($p<0.05$) increased in the rats that received ETP compared to sham/naïve rats. The number of c-Fos expressing neurons significantly reduced in rats that received QX-CAP anaesthetic prior to ETP. (C) Sections showing Vc regions taken from different rat groups contralateral to ETP. (D) Bar graph shows the average number of c-Fos expressing neurons per section contralateral to ETP for different rat groups. The number of c-Fos expressing neurons increased in the rats

that received ETP compared to sham/naïve rats. The number of c-Fos expressing neurons reduced in rats that received QX-CAP anaesthetic prior to ETP although it was not statistically significant.

B. NTS regions

c-Fos expressing neurons were very few in NTS of the naïve rats. In sham operated rats the number increased bilaterally but it was not significantly different than naïve rats (Figure 3). In the rats that received ETP, the number of c-Fos expressing neurons significantly increased bilaterally compared to naïve and sham operated rats (Figure 3). Prior application of QX-CAP anesthetic near the mandibular and mental nerve areas reduced the number of c-Fos expressing neurons in the NTS, bilaterally, however, the difference was not statistically significant (Figure 3).

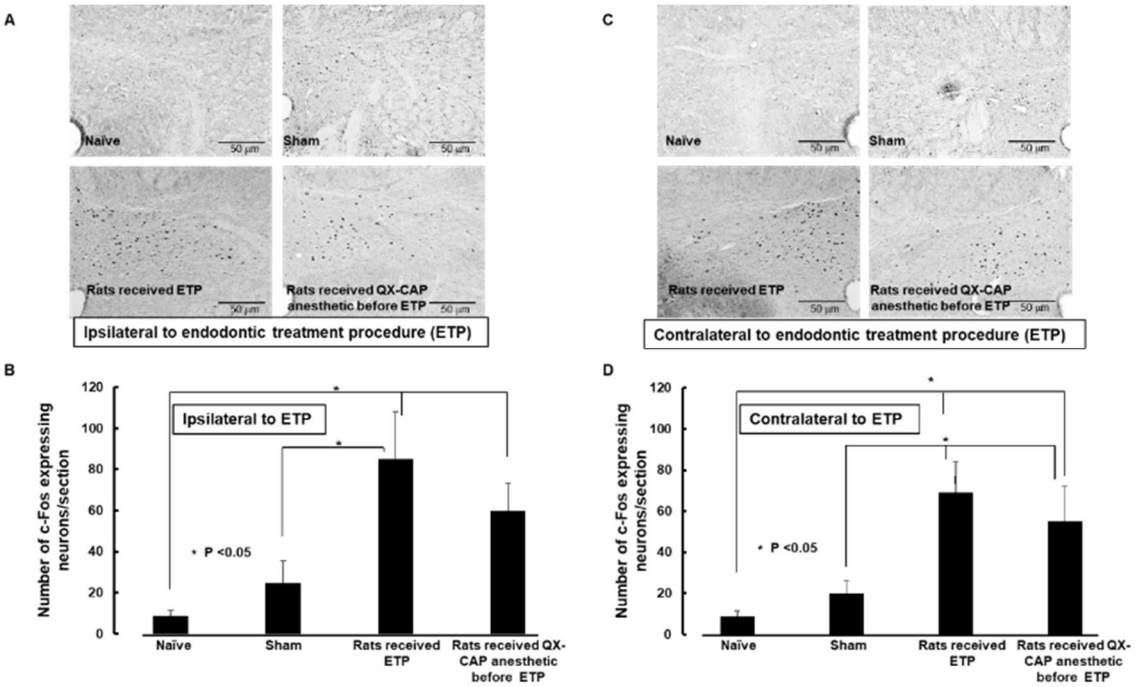

Figure 3. (A) Sections showing NTS regions taken from different rat groups ipsilateral to ETP. (B) Bar graph shows the average number of c-Fos expressing neurons per section ipsilateral to ETP for different rat groups. The number of c-Fos expressing neurons significantly ($p<0.05$) increased in the rats that received ETP compared to sham/naïve rats. The number of c-Fos expressing neurons reduced in rats that received QX-CAP anaesthetic prior to ETP, however, the difference was not statistically significant. (C) Sections showing NTS regions taken from different rat groups contralateral to ETP. (D) Bar graph shows the average number of c-Fos expressing neurons per section contralateral to ETP for different rat groups. The number of c-Fos expressing neurons increased in the rats that received ETP compared to sham/naïve rats. The number of c-Fos expressing neurons reduced in rats that received QX-CAP anaesthetic prior to ETP, however, it difference was not statistically significant.

◎考察

The above findings suggest that endodontic treatment procedure (ETP) activate neurons in the Vc and NTS regions of the brainstem. Local application of QX-CAP anaesthetic near the nerves prior to ETP reduce the number of neuronal activation. Therefore, this anaesthetic can be used during the endodontic treatments.

５．主な発表論文等

〔雑誌論文〕　計14件（うち査読付論文　14件／うち国際共著　5件／うちオープンアクセス　5件）

１．著者名 Zakir Hossain M.、Masuda Yuji、Kitagawa Junichi	４．巻 62
２．論文標題 A novel approach for detection of functional expression of TRPV1 channels on regenerated neurons following nerve injury	５．発行年 2020年
３．雑誌名 Journal of Oral Science	６．最初と最後の頁 136～139
掲載論文のDOI（デジタルオブジェクト識別子） 10.2334/josnusd.19-0356	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 －

１．著者名 Hossain Mohammad Zakir、Ando Hiroshi、Unno Shumpei、Kitagawa Junichi	４．巻 21
２．論文標題 Targeting Peripherally Restricted Cannabinoid Receptor 1, Cannabinoid Receptor 2, and Endocannabinoid-Degrading Enzymes for the Treatment of Neuropathic Pain Including Neuropathic Orofacial Pain	５．発行年 2020年
３．雑誌名 International Journal of Molecular Sciences	６．最初と最後の頁 1423～1423
掲載論文のDOI（デジタルオブジェクト識別子） 10.3390/ijms21041423	査読の有無 有
オープンアクセス オープンアクセスとしている（また、その予定である）	国際共著 －

１．著者名 Hossain Mohammad Zakir、Ando Hiroshi、Unno Shumpei、Nakamoto Tetsuji、Kitagawa Junichi	４．巻 32
２．論文標題 Functional involvement of acid‐sensing ion channel 3 in the swallowing reflex in rats	５．発行年 2019年
３．雑誌名 Neurogastroenterology & Motility	６．最初と最後の頁 e13728
掲載論文のDOI（デジタルオブジェクト識別子） 10.1111/nmo.13728	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 －

１．著者名 Kamaruddin Mohammad Firdaus、Hossain Mohammad Zakir、Mohamed Alabsi Aied、Mohd Bakri Marina	４．巻 55
２．論文標題 The Antiproliferative and Apoptotic Effects of Capsaicin on an Oral Squamous Cancer Cell Line of Asian Origin, ORL-48	５．発行年 2019年
３．雑誌名 Medicina	６．最初と最後の頁 322～322
掲載論文のDOI（デジタルオブジェクト識別子） 10.3390/medicina55070322	査読の有無 有
オープンアクセス オープンアクセスとしている（また、その予定である）	国際共著 該当する

1．著者名 Hossain Mohammad、Bakri Marina、Yahya Farhana、Ando Hiroshi、Unno Shumpei、Kitagawa Junichi	4．巻 20
2．論文標題 The Role of Transient Receptor Potential (TRP) Channels in the Transduction of Dental Pain	5．発行年 2019年
3．雑誌名 International Journal of Molecular Sciences	6．最初と最後の頁 526～526
掲載論文のDOI（デジタルオブジェクト識別子） 10.3390/ijms20030526	査読の有無 有
オープンアクセス オープンアクセスとしている（また、その予定である）	国際共著 該当する

1．著者名 Bakri Marina M.、Yahya Farhana、Munawar Khalil Munawar Makhdum、Kitagawa Junichi、Hossain Mohammad Zakir	4．巻 89
2．論文標題 Transient receptor potential vanilloid 4 (TRPV4) expression on the nerve fibers of human dental pulp is upregulated under inflammatory condition	5．発行年 2018年
3．雑誌名 Archives of Oral Biology	6．最初と最後の頁 94～98
掲載論文のDOI（デジタルオブジェクト識別子） 10.1016/j.archoralbio.2018.02.011	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 該当する

1．著者名 Hossain Mohammad、Ando Hiroshi、Unno Shumpei、Masuda Yuji、Kitagawa Junichi	4．巻 19
2．論文標題 Activation of TRPV1 and TRPM8 Channels in the Larynx and Associated Laryngopharyngeal Regions Facilitates the Swallowing Reflex	5．発行年 2018年
3．雑誌名 International Journal of Molecular Sciences	6．最初と最後の頁 4113～4113
掲載論文のDOI（デジタルオブジェクト識別子） 10.3390/ijms19124113	査読の有無 有
オープンアクセス オープンアクセスとしている（また、その予定である）	国際共著 －

1．著者名 Kamimura Rantaro、Hossain Mohammad Z.、Unno Shumpei、Ando Hiroshi、Masuda Yuji、Takahashi Kojiro、Otake Masanori、Saito Isao、Kitagawa Junichi	4．巻 60
2．論文標題 Inhibition of 2-arachydonoylgycerol degradation attenuates orofacial neuropathic pain in trigeminal nerve-injured mice	5．発行年 2018年
3．雑誌名 Journal of Oral Science	6．最初と最後の頁 37～44
掲載論文のDOI（デジタルオブジェクト識別子） 10.2334/josnusd.17-0005	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 －

1．著者名 Matoba Hiroshi、Kanayama Hayato、Kato Takafumi、Hossain Mohammad Z.、Kitagawa Junichi、Takehana Yoshie、Yamada Kazuhiro、Masuda Yuji	4．巻 60
2．論文標題 Temporal change in the occlusal vertical dimension and its involvement in modulation of jaw movement in bite-reduced animals	5．発行年 2018年
3．雑誌名 Journal of Oral Science	6．最初と最後の頁 170～176
掲載論文のDOI（デジタルオブジェクト識別子） 10.2334/josnusd.17-0122	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 －

1．著者名 Hossain Mohammad Zakir、Unno Shumpei、Ando Hiroshi、Masuda Yuji、Kitagawa Junichi	4．巻 18
2．論文標題 Neuron-Glia Crosstalk and Neuropathic Pain: Involvement in the Modulation of Motor Activity in the Orofacial Region	5．発行年 2017年
3．雑誌名 International Journal of Molecular Sciences	6．最初と最後の頁 2051～2051
掲載論文のDOI（デジタルオブジェクト識別子） 10.3390/ijms18102051	査読の有無 有
オープンアクセス オープンアクセスとしている（また、その予定である）	国際共著 －

1．著者名 Hossain Mohammad Zakir、Daud Sulinda、Nambiar Phrabhakaran、Razak Fathilah Abdul、Ab-Murat Norintan、Saub Roslan、Bakri Marina M.	4．巻 80
2．論文標題 Correlation between numbers of cells in human dental pulp and age: Implications for age estimation	5．発行年 2017年
3．雑誌名 Archives of Oral Biology	6．最初と最後の頁 51～55
掲載論文のDOI（デジタルオブジェクト識別子） 10.1016/j.archoralbio.2017.03.018	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 該当する

1．著者名 Hossain Mohammad Zakir、Shinoda Masamichi、Unno Shumpei、Ando Hiroshi、Masuda Yuji、Iwata Koichi、Kitagawa Junichi	4．巻 59
2．論文標題 Involvement of microglia and astroglia in modulation of the orofacial motor functions in rats with neuropathic pain	5．発行年 2017年
3．雑誌名 Journal of Oral Biosciences	6．最初と最後の頁 17～22
掲載論文のDOI（デジタルオブジェクト識別子） 10.1016/j.job.2016.11.003	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 －

１．著者名 Bakri MM、Hossain MZ、Razak FA、Saqina ZH、Misroni AA、Ab-Murat N、Kitagawa J、Saub RB	４．巻 62
２．論文標題 Dentinal tubules occluded by bioactive glass-containing toothpaste exhibit high resistance toward acidic soft drink challenge	５．発行年 2017年
３．雑誌名 Australian Dental Journal	６．最初と最後の頁 186～191
掲載論文のDOI（デジタルオブジェクト識別子） 10.1111/adj.12484	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 該当する

１．著者名 Ando H.、Imamura Y.、Tadokoro O.、Hossin M. Z.、Unno S.、Sogawa N.、Kondo E.、Kitagawa J.	４．巻 49
２．論文標題 Expression of Calcium-Binding Proteins, Calbindin D28k and Calretinin, in the Frog Taste Receptor Structures	５．発行年 2017年
３．雑誌名 Neurophysiology	６．最初と最後の頁 254～260
掲載論文のDOI（デジタルオブジェクト識別子） 10.1007/s11062-017-9679-x	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 －

〔学会発表〕　計16件（うち招待講演　3件／うち国際学会　1件）

１．発表者名 Mohammad Zakir Hossain、安藤　宏、海野　俊平、増田　裕次、北川　純一
２．発表標題 咽頭・喉頭領域に発現している様々なイオンチャネルと嚥下反射の関連
３．学会等名 第61回歯科基礎医学会学術大会
４．発表年 2019年

１．発表者名 Mohammad Zakir Hossain、Hiroshi Ando、Shumpei Unno、Junichi Kitagawa
２．発表標題 Acid-sensing ion channels 3 (AISC3s) in the larynx and associated laryngopharyngeal region is functional to induce the swallowing reflex
３．学会等名 第１３回 三叉神経領域の感覚-運動統合機構研究会
４．発表年 2019年

１．発表者名
安藤　宏、Mohammad Zakir Hossain、 海野　俊平、増田　裕次、北川　純一

２．発表標題
上喉頭神経に発現しているTRP、ASICおよびPiezoチャネルと嚥下誘発

３．学会等名
第53回日本味と匂学会

４．発表年
2019年

１．発表者名
安藤 宏、Mohammad Zakir Hossain、海野 俊平、増田 裕次、北川 純一

２．発表標題
喉頭・領域を支配する上喉頭神経における TRP、ASIC および Piezo チャ ネルの発現

３．学会等名
第61回歯科基礎医学会学術大会

４．発表年
2019年

１．発表者名
Mohammad Zakir Hossain、Hiroshi Ando、Shumpei Unno、Yuji Masuda、Junichi Kitagawa

２．発表標題
Utilizing the TRPV1 and TRPM8 channels to facilitate the swallowing

３．学会等名
9th Federation of the Asian and Oceanian Physiological Societies Congress (FAOPS2019)（国際学会）

４．発表年
2019年

１．発表者名
Hossain MZ, Unno S, Ando H, Masuda Y, Kitagawa J

２．発表標題
Pharmacological approach to improve swallowing function: utilizing TRPV1 and TRPM8 channels to facilitate the evoking of swallowing reflex

３．学会等名
第27回神経行動薬理若手研究者の集い

４．発表年
2018年

１．発表者名
Hossain MZ, Unno S, Ando H, Masuda Y, Kitagawa J

２．発表標題
Involvement of TRP channels to facilitate the evoking of swallowing reflex

３．学会等名
第60回歯科基礎医学会学術大会

４．発表年
2018年

１．発表者名
Ando H, Hossain MZ, Unno S, Masuda Y, Kitagawa J

２．発表標題
Expression of TRPV1, TRPM8 and TRPA1 channels in the superior laryngeal nerve innervating the laryngeal and associated laryngopharyngeal regions

３．学会等名
第60回歯科基礎医学会学術大会

４．発表年
2018年

１．発表者名
安藤 宏, Mohammad Zakir Hossain, 海野俊平, 増田裕次, 北川純一

２．発表標題
咽頭・喉頭領域を支配する上喉頭神経におけるTRPV1、TRPM8およびTRPA1チャネルの発現と嚥下の促進

３．学会等名
日本味と匂学会第52回大会

４．発表年
2018年

１．発表者名
海野俊平, Mohammad Zakir Hossain, 安藤宏, 北川純一

２．発表標題
カプサイシンおよびメントールによる嚥下機能改善の検討

３．学会等名
第16回日本機能性食品医用学会

４．発表年
2018年

１．発表者名
Mohammad Zakir Hossain, Shumpei Unno, Hiroshi Ando, Yuji Masuda, Junichi Kitagawa

２．発表標題
Sensory and motor functions in the larynx and associated laryngopharyngeal areas utilize TRP channels

３．学会等名
The 59th Annual Meeting of the Japan Society for Oral Biology（招待講演）

４．発表年
2017年

１．発表者名
Mohammad Zakir Hossain, Shumpei Unno, Hiroshi Ando, Yuji Masuda and Junichi Kitagawa

２．発表標題
Involvement of TRPM8 in mediating the superior laryngeal nerve activity and facilitating the triggering of swallowing reflex

３．学会等名
Oral Neuroscience, 2017.（招待講演）

４．発表年
2017年

１．発表者名
Mohammad Zakir Hossain

２．発表標題
Current Status of the Dental Education System in Bangladesh and Malaysia

３．学会等名
36th General and Scientific Meeting of the Japanese Dental Education Association（招待講演）

４．発表年
2017年

１．発表者名
Rantaro Kamimura, Mohammad Zakir Hossain, Shumpei Unno, Hiroshi Ando, Yuji Masuda, Kojiro Takahashi, Masanori Otake, Isao Saito, Junichi Kitagawa.

２．発表標題
Involvement of the endocannabinoid (2-Arachidonoylglycerol) in inhibition of neuropathic pain following an injury to the trigeminal nerve in mice

３．学会等名
The 40th Annual Meeting of the Japan Neuroscience Society

４．発表年
2017年

１．発表者名
安藤　宏、Mohammad Zakir Hossain、 海野　俊平、増田　裕次、北川　純一

２．発表標題
咽頭・喉頭領域におけるTRPV1およびTRPM8の発現

３．学会等名
第85回　松本歯科大学学会

４．発表年
2017年

１．発表者名
海野　俊平、Mohammad Zakir Hossain、 安藤　宏、増田　裕次、北川　純一

２．発表標題
咽頭・喉頭領域に発現するTRPV1およびTRPM8の生理学的機能の解明

３．学会等名
第85回　松本歯科大学学会

４．発表年
2017年

〔図書〕　計0件

〔産業財産権〕

〔その他〕

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６．研究組織

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