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The effect of nonfunctional tooth contact on sensory and pain perception in patients with myofascial pain of the jaw muscles

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Abstract

Purpose: The aim of this study was to examine the effect of nonfunctional tooth contact on sensory threshold (tactile detection threshold: TDT) and pain thresholds (filament-prick pain detection threshold: FPT; pressure pain threshold: PPT) in the orofacial region of patients with myofascial pain of the jaw muscles.

Methods: The study was performed on 36 subjects: 20 normal subjects and 16 patients. Using a stair-case method, TDT and FPT were measured by Semmes-Weinstein monofilaments, on the cheek skin (CS) overlying the masseter muscles (MM) and on the skin overlying the palm side of the thenar skin (TS). PPT was measured at the central part of the MM using a pressure algometer. Each parameter was measured before and after keeping light tooth contact for 5 minutes (session 1) and keeping the jaw relaxed for 5 minutes (session 2) as a control.

Results: There were significant effects of experimental condition (before - after 5 minutes) on the TDT and FPT at several sites: after 5minutes, TDT was higher in all measurement sites except the left CS of the patients in session 2. As for the FPT, the reactions between CS and TS were quite opposite in both sessions: after 5 minutes, the FPT at the CS decreased and/or remained, but the FPT at the TS increased and/or remained. Significant session effects (session 1 - session 2) were only found on the FPT at the CS in patients.

Conclusion: Sensitivity to FPT was more susceptible to tooth contact condition, especially in the patients.

Keywords:
orofacial pain, quantitative sensory testing, nonfunctional tooth contact, habituation, sensitization

Introduction

Pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damages (1). The dentist has a great responsibility in the assessment, diagnosis and management of orofacial pain. Out of a variety of measurement techniques of pain, e.g., subjective reporting, behavioral and physiologic responses, electromyographic recordings of jaw reflexes and functional brain imaging (2), quantitative sensory testing is relatively easy to use and psychophysical procedures will hopefully allow us to better objectify pain and dysfunction (3). In previous studies, we tested pressure pain thresholds (PPT) and psychophysics which were also tested for their application in the diagnosis of dysfunction and pain (4-9).

While different pain responses were found between patients with myofascial pain and normal subjects (9-12), there does not appear to be extensive evidence for differences in sensory characteristics of the cutaneous perception between patients with temporomandibular disorders (TMD) and normal subjects. Davison and Gale (13) reported that the cutaneous sensory thresholds of the skin overlying the masseter muscle were higher in patients than in normal subjects. The vibro-tactile threshold was significantly elevated on the cheek skin in TMD patients (14). Chronic cervicobrachialgia patients exhibited significantly higher detection thresholds for light touch on the skin of the pain provoking segment (15). Similar to these cases of clinical pain, Stohler et al. (16) found that experimentally induced pain in the masseter muscle reduced the cutaneous mechanosensitivity at the site of pain.

Recently, we reported that in symptom-free subjects, non-functional tooth contact, which is considered a possible risk factor in the development of myofascial orofacial pain (17) does not result in more modulation of tactile and pain thresholds in the face, than what could be ascribed to habituation (18). It was striking that not only sensitivity to pain but also habituation of sensory perception was higher in women than men (18). Further exploration whether these effects are similar in patients suffering from myofascial pain of the jaw muscles might help to clarify the physiological reactions in patients developing pain and dysfunction.

The aim of this study was 1) to examine the effect of nonfunctional tooth contact on sensory and pain perception in the orofacial region of patients with

myofascial pain of the jaw muscles and 2) to compare these effects to those in symptom free subjects, which might help to clarify the physiological reactions in patients developing pain and dysfunction.

Materials and methods

Patients and Normal Subjects

The study was performed on 36 subjects: 20 female normal subjects (age range 21 to 42 years, mean age ± S.D. 30.8 ± 6.5 years) and 16 female patients with myofascial pain of the jaw muscles, as determined using the Research Diagnostic Criteria (age range 21 to 59 years, mean age ± S.D. 40.5 ± 12.9 years). In the patients, six patients had bilateral and ten patients had unilateral masticatory muscle pain. Normal subjects were recruited from university students and staff. All were asymptomatic for pain in the head and neck. All patients were referred to the Department of Oral and Maxillofacial Surgery of the Catholic University of Leuven (K.U.Leuven). The patients had a mean weight of 65.8 ± 12.6 kg, while the normal subjects had a mean weight of 55.4 ± 8.6 kg. The mean height was 166.0 ± 4.2 cm for the patients and 164.9 ± 7.8 cm for the normal subjects. As a previous study indicated that pain thresholds were lower in the menstrual phase, women were not tested during their menstrual phase and smokers were excluded (5,19). Informed consent was obtained from all participants. The institutional ethics committee approved the study.

Tactile detection threshold and filament-prick pain detection threshold

The tactile detection threshold (TDT) and the filament-prick pain detection threshold (FPT) were measured 1) on the cheek skin (CS) overlying the central part of the left and right masseter muscles midway between the upper and lower borders and 1 cm posterior to the anterior border, and 2) on the skin overlying the palm side of the thenar muscle on the point connecting the longitudinal axis of the thumb and index finger (thenar skin: TS). The sequence of the measurement sites was randomized. Semmes-Weinstein monofilaments with 20 different diameters were used (Premier Products, USA). The numbers of the filaments (1.65 to 6.65) correspond to a logarithmic function of the equivalent forces of 0.0045 to 447 gram.

At first, TDT was examined. The subjects were instructed to close their eyes during the whole test procedure and to raise their hand as soon as they felt the stimulus on the test site. The filament was applied vertically to the test site and slowly pressure was applied until the filament bowed. The time needed to bow the filament was standardized to approximately 1.5 seconds. The stimulus was maintained for approximately 1.5 seconds and then removed in 1.5 seconds. Quick applications and bouncing of the filaments against the skin were avoided. At each site, the test started with the number (No.) 4.74 filament. If the subject raised his/her hand, it was considered a positive response, and the next filament applied was one step lower (No. 4.56). This procedure was repeated with decreasing filament diameters until the subject no longer felt the pressure. This was considered a negative answer. Again, the filament with a higher pressure was applied. This procedure continued until five positive and five negative peaks were recorded and the threshold (TDT) was calculated as the average of these values (number of the filament). If the subject still had a positive response while applying the lowest fiber (No. 1.65), this pressure was considered the threshold. Two “blank” (placebo) trials were performed after peaks 5 and 10. During these control trials, the filament did not make contact with the tissue. If the subject reported a positive answer, the test was discontinued and the subject was questioned about what kind of stimulus was perceived. The whole procedure was explained again to the subject and afterwards the test was restarted (6,8,18).

After the TDT measurements, the FPT was examined. The stimuli were applied in the same way as for the TDT, but the subjects were instructed to keep their eyes open and to raise their hand as soon as they felt not only pressure but also pain in the test area. If the subject had no positive response for the thickest fiber (No. 6.65), this value was recorded as the threshold. No placebo stimulus was applied. There was a time lag of 3 minutes between the measurements on a similar site in order to avoid sensitization. Furthermore, after the examination, the pain intensity experienced at the FPT was assessed on a numeric rating scale (NRS) where 0 cm indicated ‘no pain’ and 10 cm indicated ‘worst pain imaginable’.

Pressure pain threshold

A pressure algometer (Somedic, Sweden) was used to test the sensitivity to

stimuli applied to the masseter muscles. The pressure pain threshold (PPT) was defined as the amount of pressure (kPa), which the subjects first perceived to be painful (12). The PPT was determined with a constant application rate of 30 kPa/s and a probe diameter of 1 cm. The subject pushed a button to stop the pressure stimulation when the threshold was reached. These measurements were done at least 5 minutes after the FPT measurement. Measuring point was the central part of the masseter muscle (MM) midway between the upper and lower borders and 1 cm posterior to the anterior border. This point was identical to the one used for measuring TDT and FPT. At the start of the session, the subjects were familiarized with the measurement procedure and the equipment via a demonstration on the forearm, and they were instructed to keep their teeth slightly apart to avoid contraction of the jaw-closing muscles during stimulation. While the PPT was being assessed, the subject's head was supported by counter-pressure from the opposite hand of the examiner. The measurements of the PPT were done three times. There was a time interval of 2 minutes between the measurements. The mean value of the three measurements was used for further statistical analysis. After the examination, the average pain during PPT measurement was assessed on a NRS where 0 cm indicated 'no pain' and 10 cm indicated 'worst pain imaginable'.

Measurement sessions and Statistical analysis

Each parameter was measured before and after keeping nonfunctional tooth contact (the teeth together in maximal occlusion, without exerting extra forces) for 5 minutes (session 1) and keeping the jaw relaxed for 5 minutes (session 2) as a control. The two measurement sessions were separated by 1 week and the order randomized.

Since PPTs were normally distributed but TDTs and FPTs were not, subsequent analysis was performed with Wilcoxon matched pair test for TDTs, FPTs and paired t-test for PPTs. To test the effects of the session and experimental condition, all data were compared between session 1 and session 2, and before and after 5 minutes, respectively. To compare the differences between patients and normal subjects (case – control differences), Wilcoxon-Mann-Whitney test and unpaired t-test were used for TDTs, FPTs and PPTs, respectively. The significance was accepted at $P < 0.05$.

Results

There were no side differences between left CS and right CS regarding TDT and FPT in the patients (t-test; TDT; P = 0.534, FPT; P = 0.464) and the normal subjects (t-test; TDT; P = 0.806, FPT; P = 0.859).

Case-control differences

Since there were no significant differences between the data measured prior to the experimental conditions in session 1 and session 2, the data prior to the experimental conditions in 2 sessions were averaged in order to obtain a single value, and those values of 3 thresholds (TDT, FPT and PPT) were compared between normal subjects and patients (Table 1). The TDT at left CS, right CS and TS were 2.74 ± 0.49, 2.77 ± 0.52 and 3.00 ± 0.43 in normal subjects and 3.40 ± 0.80, 3.26 ± 0.88 and 3.57 ± 0.74 in patients, respectively. The FPT at left CS, right CS and TS were 6.00 ± 0.56, 6.02 ± 0.56 and 5.95 ± 0.49 in normal subjects and 6.01 ± 0.73, 5.89 ± 0.60 and 6.04 ± 0.49 in patients, respectively. The PPT at MM was 118.1 ± 52.2 kPa in normal subjects and 129.2 ± 40.0 kPa in patients, respectively. The TDT at all sites was found to be significantly higher in patients than in normal subjects (t-test; left CS; P = 0.001, right CS; P = 0.020, TS; P = 0.001). There were no significant case-control differences in the FPT (t-test; left CS; P = 0.441, right CS; P = 0.316, TS; P = 0.371) and the PPT (t-test; left MM; P = 0.312) (Table 1).

In fact, the two measurement sessions were separated by 1 week and all parameters (TDT, FPT and PPT) were measured before and after each experimental condition in 2 sessions. And so, figures show all data of each threshold (TDT, FPT and PPT) before and after each experimental condition of normal subjects and patients (Fig. 1, 2, 3).

Tactile detection threshold

There were no significant session effects (session 1 - session 2) on the TDT. After 5minutes, TDT was higher in all measurement sites except the left CS of the patients in session 2, and there were significant effects of experiment condition (before - after 5 minutes) on the TDT in the normal subjects (session 1:

left CS; $P < 0.01$, right CS; $P < 0.01$, TS; $P < 0.01$; session 2: left CS; $P < 0.01$, right CS; $P < 0.01$) and patients (session 1: right CS; $P < 0.05$; session 2: TS; $P < 0.05$) (Fig. 1).

Filament-prick pain detection threshold

As for the FPT, significant effects of experimental condition were observed in the normal subjects (session 1: left CS; $P < 0.05$, TS; $P < 0.05$; session 2: TS; $P < 0.05$) and patients (session 1: right CS; $P < 0.01$). After 5 minutes, the FPT at TS of the normal subjects increased in both sessions (session 1: $P < 0.05$; session 2: $P < 0.05$) but the FPT at the left CS of the normal subjects and the right CS of the patients decreased significantly in session 1 (session 1: left CS of normal subjects; $P < 0.05$, right CS of patients; $P < 0.01$). There were significant session effects (session 1 - session 2) on the FPT at the CS of the patients (left CS; $P < 0.05$, right CS; $P < 0.01$) (Fig. 2).

Pressure pain threshold

There were no significant differences regarding the PPT between the patients and normal subjects, and the reactions after 5 minutes varied little. The PPT of normal subjects increased from 114.2 ± 37.4 kPa to 116.5 ± 43.7 kPa in session 1 and from 122.0 ± 64.5 kPa to 130.2 ± 60.3 kPa in session 2. In the patients, the PPT of patients decreased from 128.4 ± 40.4 kPa to 123.0 ± 38.4 kPa in session 1 and from129.9 ± 40.9 kPa to 128.5 ± 44.1 kPa in session 2 (Fig. 3).

Discussion

Many orofacial pain conditions will have both a spontaneous component and also a stimulus-evoked component. It is important to distinguish between pain evoked by different stimulus modalities, e.g., mechanical, thermal, chemical or electrical stimuli (20). In the clinic, we test the mechanical sensitivity of skin and muscles by standardized palpation and recording the graded responses from the patient. In our study, we used Semmes-Weinstein monofilaments and a pressure algometer to examine the effect of nonfunctional tooth contact, which is considered a possible risk factor in the development of myofascial orofacial pain on sensory and pain perception in the orofacial region.

The functions of the trigeminal sensory and motor systems are very analogous to those of the hand, particularly in relation to the precise manipulation of objects. This is reflected in the exceptional innervation density of the perioral tissues and the hand, and the large areas of sensory and motor cortex that process the sensory information and control the motor activities of these two vital areas of the body. The face and cheeks resemble the hairy skin of the hand and arm, whereas the sensory innervation of the tongue tip resembles that of the finger tips (20). The testing of the TS, therefore was not only a “control site” in view of the presence of pain, but also a region with some similar characteristics.

The reproducibility of quantitative sensory testing on tactile and pain perception during subsequent sessions separated by 1 week confirmed findings of previous studies (8,18).

As for the previous case-control reports, it has been shown already earlier that a difference may exist between pain perception (unilateral or bilateral) and the response to a provoked pain, as in the PPT measurement (9-12). One of the suggested etiologic factors in myofascial pain is central sensitization, which of course results in decreased PPTs in all muscles. The fact that there was no significant difference between patients and normal subjects for the PPT of the masseter muscle in our study might be caused by the limited number of participants which were not controlled for age or weight. On the other hand, the fact that tactile sensory thresholds (TDT) were higher in the patients than in the normal subjects is in good agreement with previous reports using not only mechanical but also electrical stimulation and vibration test. Davison and Gale (13) reported that the cutaneous sensory thresholds of the skin overlying the masseter muscle were higher in the patients than in the normal subjects. The vibro-tactile threshold was significantly elevated on the cheek skin in TMD patients (14). Chronic cervicobrachialgia patients exhibited significantly higher detection thresholds for light touch on the skin of the pain provoking segment (15). Stohler et al. (16) found that experimentally induced pain in the masseter muscle also reduced the cutaneous mechanosensitivity at the site of pain. To account for these results, Apkarian et al. (21) proposed the existence of a ‘touch gate’, analogous in some ways to the pain gate described by Melzack and Wall (22,23). There might be also other possibilities: adaptation processes at the level of peripheral afferent and/or central processes at the thalamic and cortical levels might be different between the normal subjects and the patients.

Learning is essential for both human and animal to live and survive and its

process is divided into the non-associative learning and associative learning. The associative learning comprises classical conditioning (conditioned response and/or conditioned reflex) and operant conditioning. On the other hand, non-associative learning involves habituation and sensitization (24). Habituation is a quite different reaction from sensitization; the former is a decrease or loss of response following repetitive stimulation and the latter is the increased excitability of a reaction produced by trauma and inflammation of peripheral tissues, and can occur peripherally or centrally or both (25). The increase of TDT after tooth contact/no contact in the present study can be considered habituation, and it was found in both patients with myofascial pain and normal subjects.

The FPT at TS of the normal subjects was significantly higher in both sessions, however, the FPT at left CS of the normal subjects and right CS of the patients was significantly lowered after keeping tooth contact for 5 minutes. As mentioned earlier (20), the sensory innervation of the face and cheek resembles that of the hairy skin of the hand and arm. However, visual information could play a role in the hand and arm but not in the face and cheek even with open eyes. This visual feedback might be considered in the different reaction between CS and TS: the increase and decrease of FPT after tooth contact/no contact could be habituation and sensitization, respectively. Interestingly, habituation found in the normal subjects was not found in the patients. In our previous study (18), sensitization was not found in the same condition. So we need bigger sample size to clarify this mechanism. As for the session effects (session 1 - session 2), there were significant differences on the FPT at the CS in the patients but not in the normal subjects. This fact suggests that sensitivity to FPT was more susceptible to tooth contact condition, especially in the patients.

Conclusion

Sensitivity to FPT was more susceptible to tooth contact condition, especially in the patients.

In future studies, the duration of the pain in the patients should be taken into account since chronicity and central sensitization may play a very important role on our findings.

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References

1. Merskey H, Bogduk N, editors. Classification of Chronic Pain: Description of Chronic Pain Syndromes and Definitions of Pain Terms. Seattle: IASP Press; 1994, p. 59-76.

2. Rainville P. Measurement of pain. In: Sessle BJ, Lavigne GJ, Lund JP, Dubner R, editors. Orofacial Pain: from basic science to clinical management, 2nd ed., Chicago: Quintessence; 2008, p. 79-85.

3. De Laat A. The path from studying masticatory function to managing TMD and pain: A personal journey. J Dent Res 2003; 82: 8-10.

4. Drobek W, De Laat A, Schoenaers J. Tactile threshold and pressure pain threshold during treatment of orofacial pain: an explorative study. Clin Oral Invest 2001; 5: 185-193.

5. Isselee H, De Laat A, De Mot B, Lysens R. Pressure-pain threshold variation in temporomandibular disorder myalgia over the course of the menstrual cycle. J Orofac Pain 2002; 16: 105-117.

6. Jacobs R, Wu CH, Van Loven K, Desnyder M, Kolenaar B, Van Steenberghe D. Methodology of oral sensory tests. J Oral Rehabil 2002; 29: 720-730.

7. De Laat A, Stappaerts K, Papy S. Counseling and physical therapy as treatment for myofascial pain of the masticatory system. J Orofac Pain 2003; 17: 42-49.

8. Komiyama O, De Laat A. Tactile and pain thresholds in the intra- and extra-oral regions of symptom-free subjects. Pain 2005; 115: 308-315.

9. Michelotti A, Farella M, Stellato A, Martina R, De Laat A. Tactile and pain

thresholds in patients with myofascial pain of the jaw muscles: A case-control study. J Orofac Pain 2008; 22: 139-145.

10. Ohrbach R, Gale EN. Pressure pain threshold, clinical assessment, and differential diagnosis: Reliability and validity in patients with myogenic pain. Pain 1989; 39: 157-169.

11. Reid KI, Gracely RH, Dubner RA. The Influence of time, facial side, and location on pain-pressure thresholds in chronic myogenous temporomandibular disorder. J Orofac Pain 1994; 8: 258-265.

12. Svensson P, Arendt-Nielsen L, Nielsen H, Larsen JK. Effect of chronic and experimental jaw muscle pain on pain-pressure thresholds and stimulus-response curves. J Orofac Pain 1995; 9: 347-356.

13. Davison RM, Gale EN. Cutaneous sensory thresholds from skin overlying masseter and forearm in MPD patients and controls. J Dent Res 1983; 62: 555-558.

14. Hollins M, Sigurdsson A, Fillingim L, Goble AK. Vibrotactile threshold is elevated in temporomandibular disorders. Pain 1996; 67: 89-96.

15. Voerman VF, Van Egmond J, Crul BJP. Elevated detection thresholds for mechanical stimuli in chronic pain patients: Support for a central mechanism. Arch Phys Med Rehabil 2000; 81: 430-435.

16. Stohler CS, Kowalski CJ, Lund JP. Muscle pain inhibits cutaneous touch perception. Pain 2001; 92: 327-333.

17. Chen CY, Palla S, Erni S, Sieber M, Gallo LM. Nonfunctional tooth contact in healthy controls and patients with myogeneous facial pain. J Orofac Pain 2007; 21: 185-193.

18. Okayasu I, Oi K, De Laat A. The effect of tooth clenching on the sensory and pain perception in the oro-facial region of symptom-free men and women. J Oral Rehabil 2009; 36: 476-482.

19. Isselee H, De Laat A, Bogaerts K, Lysens R. Long-term fluctuations of pressure pain thresholds in healthy men, normally menstruating women and oral contraceptive users. Eur J Pain 2001; 5: 27-37.

20. Svensson P, Sessle BJ. Orofacial pain. In: Miles TS, Nauntofte B, Svensson P, editors. Clinical Oral Physiology, Copenhagen: Quintessence; 2004, p. 93-139.

21. Apkarian AV, Stea RA, Bolanowski SJ. Heat-induced pain diminishes vibrotactile perception: a touch gate. Somatosens Mot Res 1994; 11: 259-267.

22. Melzack R, Wall PD. Pain mechanisms: A new theory. Science 1965; 150: 971-979.

23. Melzack R, Wall PD. The challenge of pain. London: Penguin; 1982.

24. Morimoto T, Yamada Y, editors. Basic Physiology for Dental Students, 5th ed., Tokyo: Ishiyaku; 2008.

25. McNeill C, Dubner R, Woda A. What is pain and how do we classify orofacial pain?. In: Sessle BJ, Lavigne GJ, Lund JP, Dubner R, editors. Orofacial Pain: from basic science to clinical management, 2nd ed., Chicago: Quintessence; 2008, p. 3-11.

Figure legends

Figure 1. Tactile detection threshold (TDT) before (pre) and after (post) experimental condition of normal subjects (upper figures) and patients (lower figures). Black circles indicate session 1 (experimental condition keeping tooth contact for 5 minutes) and black squares show session 2 (experimental condition keeping the jaw relaxed for 5 minutes).
** $P < 0.01$, * $P < 0.05$ when compared between the experimental conditions of session 1.
$^{\#\#}$ $P < 0.01$, $^{\#}$ $P < 0.05$ when compared between the experimental conditions of session 2.

Figure 2. Filament-prick pain detection threshold (FPT) before (pre) and after (post) experimental condition of normal subjects (upper figures) and patients (lower figures). Black circles indicate session 1 (experimental condition keeping tooth contact for 5 minutes) and black squares show session 2 (experimental condition keeping the jaw relaxed for 5 minutes).
** $P < 0.01$, * $P < 0.05$ when compared between the experimental conditions of session 1.
$^{\#}$ $P < 0.05$ when compared between the experimental conditions of session 2.
$^{++}$ $P < 0.01$, $^{+}$ $P < 0.05$ when compared between session 1 and session 2.

Figure 3. Pressure pain threshold (PPT) before (pre) and after (post) experimental condition of normal subjects (upper figures) and patients (lower figures). Black circles indicate session 1 (experimental condition keeping tooth contact for 5 minutes) and black squares show session 2 (experimental condition keeping the jaw relaxed for 5 minutes).

Fig. 1

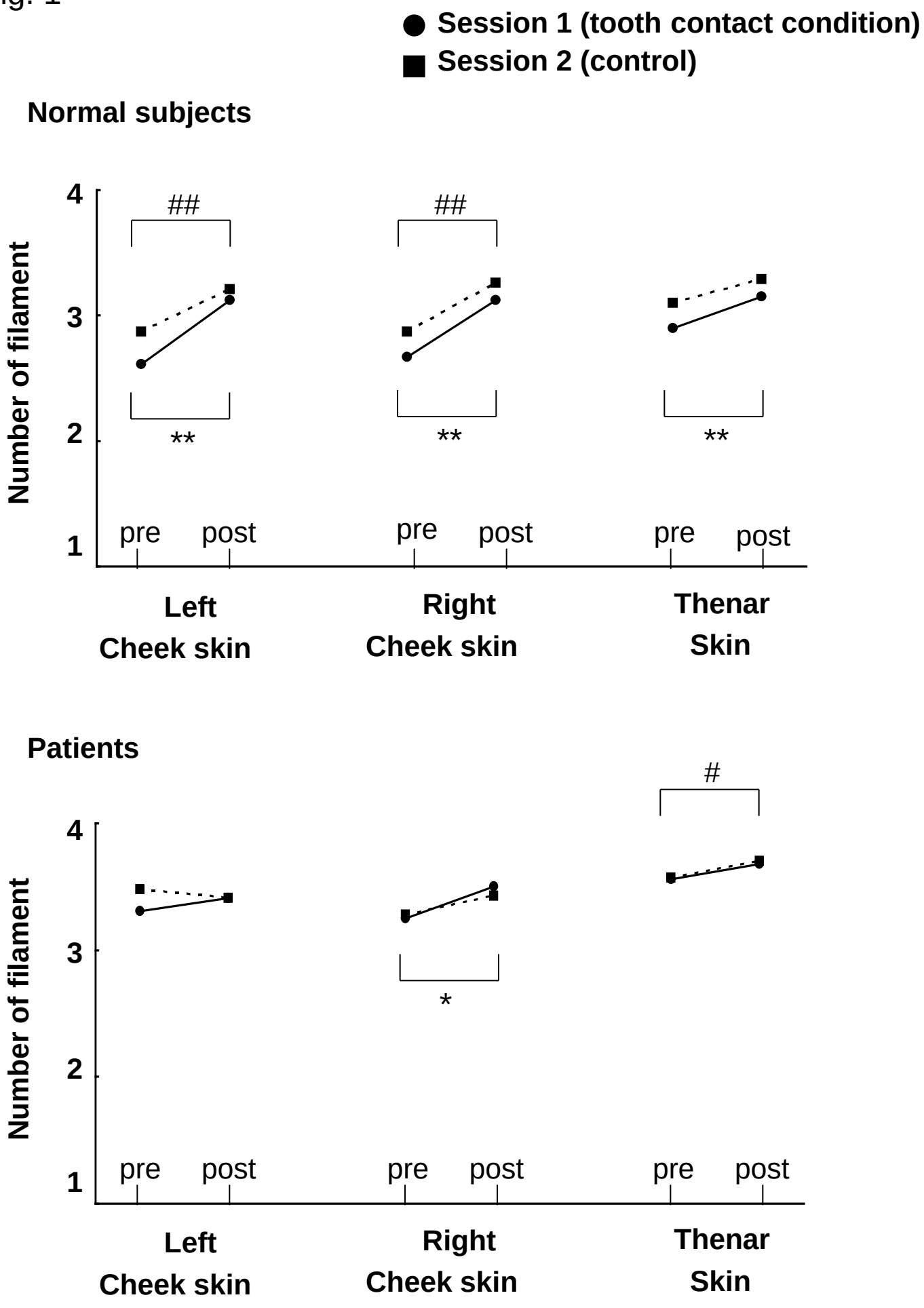
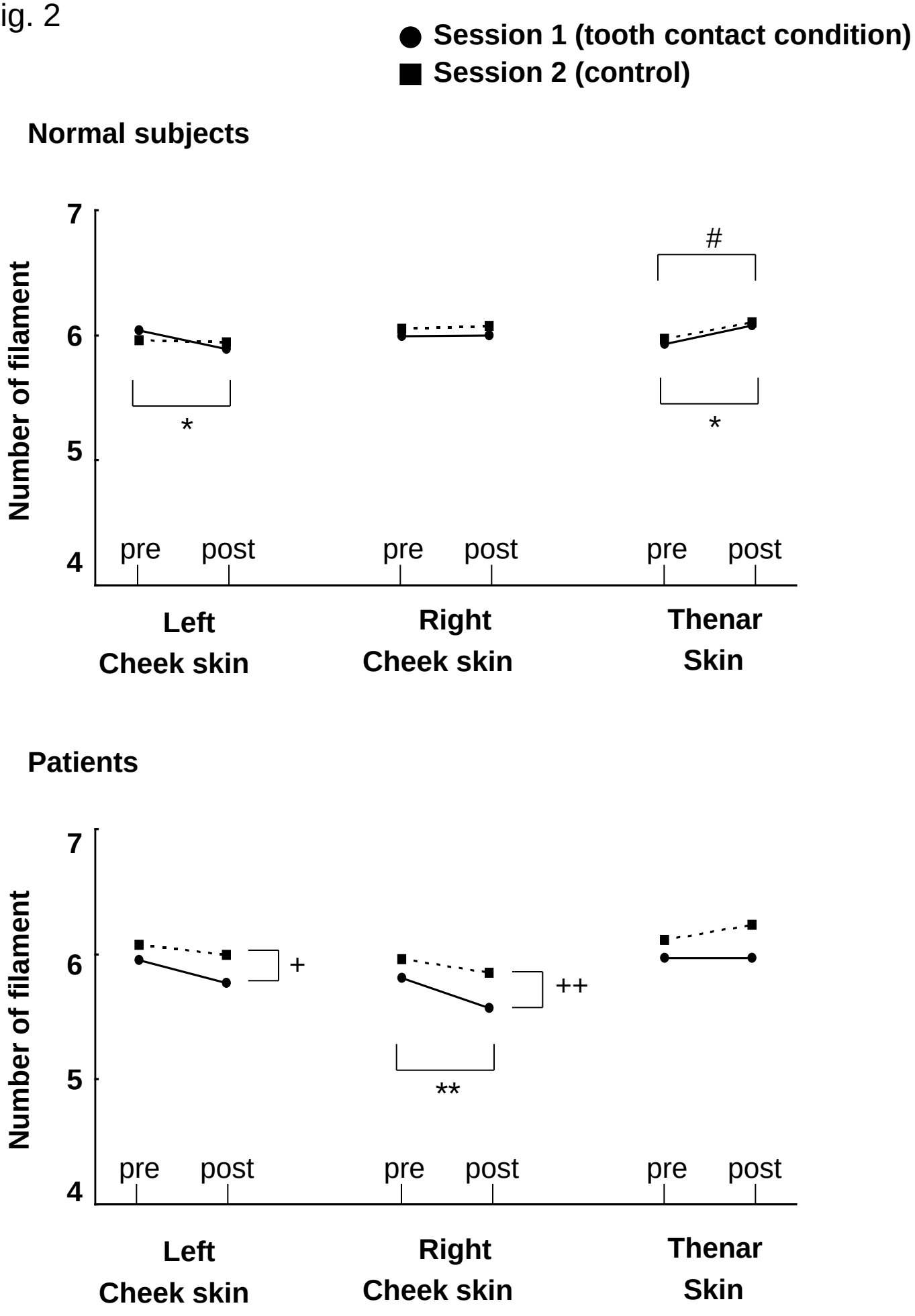

● Session 1 (tooth contact condition)
■ Session 2 (control)
Normal subjects
Number of filament
4
3
2
1
##
##
**
**
**
pre
post
pre
post
pre
post
Left Cheek skin
Right Cheek skin
Thenar Skin
Patients
Number of filament
4
3
2
1
#
*
pre
post
pre
post
pre
post
Left Cheek skin
Right Cheek skin
Thenar Skin

Fig. 2


● Session 1 (tooth contact condition)
■ Session 2 (control)
Normal subjects
Number of filament
7
6
5
4
#
*
*
pre
post
pre
post
pre
post
Left
Cheek skin
Right
Cheek skin
Thenar
Skin
Patients
Number of filament
7
6
5
4
+
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**
pre
post
pre
post
pre
post
Left
Cheek skin
Right
Cheek skin
Thenar
Skin

Fig. 3

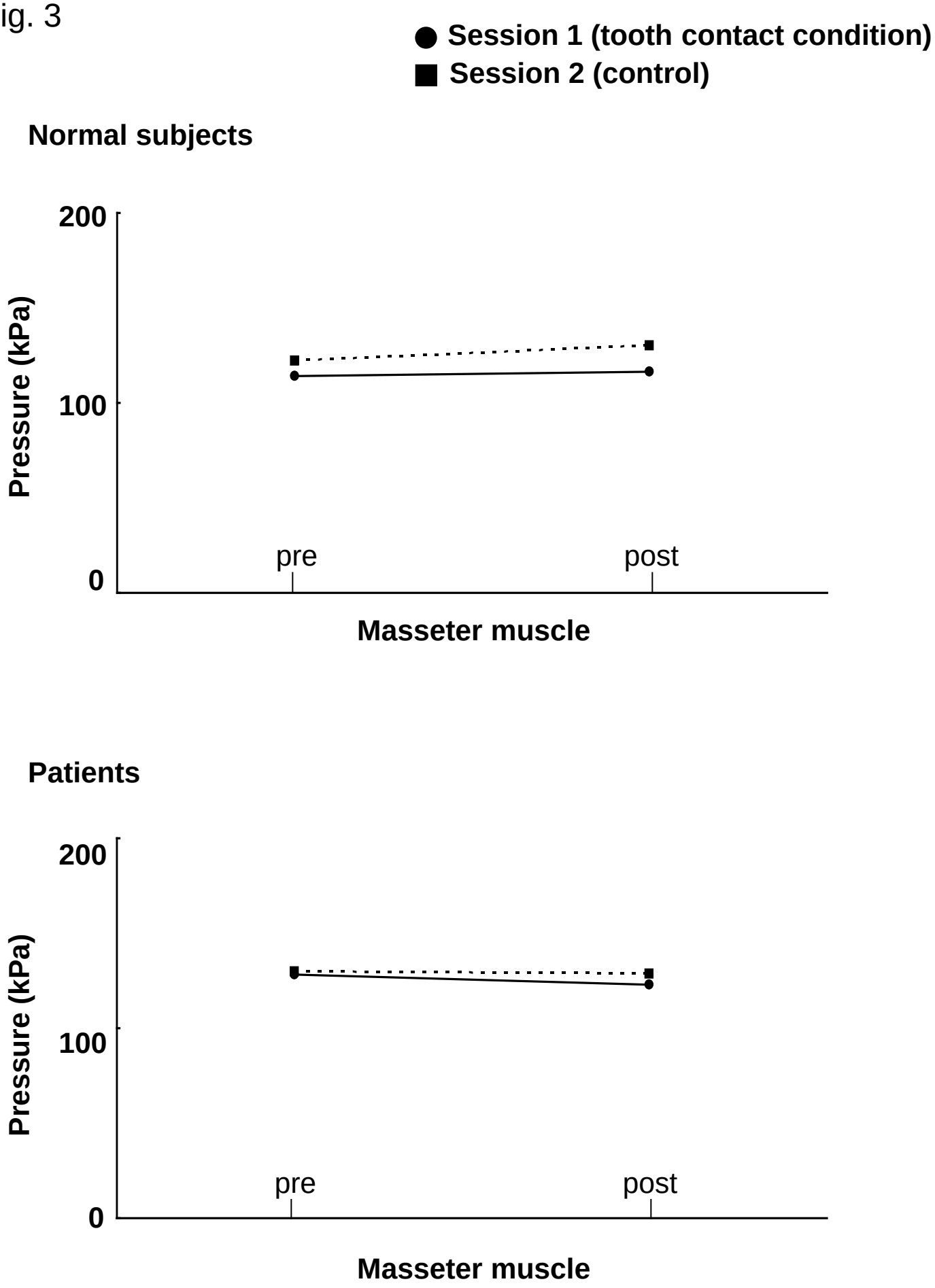
● Session 1 (tooth contact condition)
■ Session 2 (control)
Normal subjects
200
100
0
Pressure (kPa)
pre
post
Masseter muscle
Patients
200
100
0
Pressure (kPa)
pre
post
Masseter muscle

Table 1. Sensory and pain thresholds measured prior to the experimental condition in normal subjects and patients.

	Normal Subjects	Patients	*P* -value
Tactile detection threshold			
Cheek skin (Left)	2.74 ± 0.49	3.40 ± 0.80	**0.001**
Cheek skin (Right)	2.77 ± 0.52	3.26 ± 0.88	**0.020**
Thenar skin	3.00 ± 0.43	3.57 ± 0.74	**0.001**
Filament-prick pain detection threshold			
Cheek skin (Left)	6.00 ± 0.56	6.01 ± 0.73	0.441
Cheek skin (Right)	6.02 ± 0.56	5.89 ± 0.60	0.316
Thenar skin	5.95 ± 0.49	6.04 ± 0.49	0.371
Pressure pain threshold			
Masseter muscle	118.1 ± 52.2	129.2 ± 40.0	0.312

P-values in bold are significant at the 0.05 level.