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Study on the Recognition Level of Examination Baseline in Brain CT Examination

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Abstract

Compared to other tests, MRI and CT provide high-resolution images. They are capable of multi-faceted tests, making them essential equipment in medical institutions. Many medical institutions have attempted to accurately identify and treat patient diseases by performing CT scansand MRI scans in conjunction. With the increase of aging population, the number of brain CT examinations is also increasing. However, the baseline of brain CT examinations is different for each medical institution. In addition, CT and MRI examinations are applied differently for identical patients. The purpose of this study was to grasp the perception level of the baseline of brain CT and provide basic data. A structured questionnaire consisting of seven questions on the recognition level of brain CT examination baseline and six general questions was used. Selection criteria for study subjects were radiologists who had experience in brain CT examinations in medical institutions. In the surveyed questionnaire, frequency analysis was performed to understand general characteristics of survey respondents and the criteria for brain CT scout. In addition, Chi-square analysis as a crossover analysis was performed to determine the relationship between general characteristics and baseline brain CT. Statistical significance was considered when p value was less than 0.05. Recognition for the presence or absence of image difference according to CT baseline, age, and shift type was statistically significant ($p < 0.11$). Recognition for the difference in diagnostic range according to CT baseline, gender, age, CT room experience, and shift type was also statistically significant ($p < 0.11$). Recognition of CT baseline according to hospital size, CT room experience, shift type, and unification of medical institutions was also statistically significant ($p < 0.01$). In brain CT examination, it was found that examination baseline was significantly different depending on images and diagnostic ranges, unification of baselines of medical institutions, and baselines of MRI ($p < 0.11$). However, the currently used brain CT baseline is not determined. Thus, baseline is needed for brain MRI.

Keywords*:* Brain CT, Brain MRI, examinations Base line, OML, IOML, AC-PC Line

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Introduction

Currently, the development of examination equipment in the radiology department has progressed rapidly. In particular, Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) provide higher resolution images compared to other examinations. They are capable of multi-faceted tests, making them essential equipment in medical institutions [1,2]. Many medical institutions have tried to accurately identify and treat patient diseases by performing a simple, high-resolution, high-resolution CT scan. MRI scan allows multiple tests without exposure to radiation. The Health Insurance Review and Assessment Service reported that the number of CT examinations was 1,186,882 in 2015, 1,263,045 in 2016, and 1,283,324 in 2017, showing increases year by year. Thenumber of MRI examinations is also increasing year by year (from 204,620 in 2015 to 225,670 in 2016 and 229,342 in 2017) [3]. In 1988, Talairach et al. reported the AC-PC line (anterior) in the head of a human brain MRI examinations. Since then, the AC-PC line has been widely used as an examination baseline for brain examinations. However, in brain CT examination using radiation, determining AC-PC line is not as easy as that in brain MRI [4]. Therefore, the AC-PC line is not suitable for use as abaseline for brain CT examinations. In current CT, the examination baseline is the orbito-meatal line (OML) connecting the center of the mandible and the external auditory meatus (EAM). OML is widely used in brain CT examinations. OML can be find by direct visual inspection of a patient's Scout image. Since OML is determined by direct visual inspection based on soft tissue marks, there are many differences from thebaseline of the MRI scan [5-6]. Therefore, the purpose of this study was to grasp theperception level of the baseline of brain CT and provide basic data.

Study subjects and methods

research subjects

A structured questionnaire consisting of seven questions related to the recognition level of brain CT examination baseline and six general questions was used. The questionnaire was conducted as a mobile questionnaire to minimize direct visits to medical institutions due to COVID-19. Research tasks, subjects, time required, and precautions when responding to the questionnaire were provided as explanatory texts. Inquiries relate

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d to the study or discontinuation of the study were available by contacting the resear ch director via email or mobile phone. Selection criteria for study subjects were radio logists with experience in brain CT examinations who were operating CT's in CT roo ms of medical institutions. As for the exclusion criteria, radiologists who had not perf ormed CT scans and radiologists who did not perform brain CT scans were excluded from this study. When there were more than 50% unanswered items in the questionn aire, these copies were excluded from this study.

Study method

The number of study subjects required for the purpose of this study was analyzed using the G-power program (Version 3.1.9.2, University of Kiel, Kiel, Germany). In the F-test, 102 people were needed to maintain a medium effect size of 0.25 and a power of 0.8 a t a significance level of 0.05. Considering a dropout rate of 10%, 160 radiologists were selected by convenience sampling. The surveyed questionnaire used SPSS Ver. 24.0, a st atistical package. A frequency analysis was conducted to understand general characteristi cs of survey respondents and the criteria for Brain CT Scout. In addition, Chi-square ana lysis, a cross analysis, was performed to find out the relationship between general charac teristics and baseline brain CT. Statistical significance was considered when p value was less than 0.05. This study was conducted after receiving approval from the Institutional Review Board (IRB) of Howon University as a human subject study (1041585-201903-H R-02-01).

Results

General Information Analysis

As a result of analyzing general characteristics of the subjects, the following was fou nd. In terms of gender, 129 men and 31 women responded, with 63 respondents in t heir 20s and 46 in their 30s.The hospital size was 100 for university hospitals, 40 for general hospitals, 15 for hospitals, and 5 for clinics. For CT education, 158 responden ts said that they received education and two respondents said they did not. As for ed ucation method, hospital manual was used by 82 people and CT text book was used by 20 people. It was found that participants received education through hospital manu als and CT textbooks. As for CT examination baseline, OML was the most commonl

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y used one (n = 52), followed by IOML (n = 41), SOML (n = 31), and AC-PC Lin e (n = 15). Twenty-one responded that it varied from patient to patient. As for hospit al experience, 53 respondents had more than 1 year and less than 3 years, 40 respon dents had 7 years or more, 36 respondents had less than 1 year, and 20 respondents had 3 years or more but less than 5 years.

Recognition level result of image difference according to CT baseline

Results of analyzing the recognition level of image difference according to CT baselin e are as follows. According to gender, 41 men and 10 women responded that 'there i s significant difference in image', 69 men and 15 women answered that 'there is a sli ght difference', and 18 men and 5 women, responded that 'there is no difference'. Bec ause it was not statistically significant, it could be concluded that men and women di d not recognize a difference in images according to CT baseline ($p < 0.73$). In terms of age, for those in their 20s, 18 people answered "there is a lot of difference in i mage", 38 responded "there is a lot of difference in image", and 7 responded "there is no difference". For those in their 30s, 18 people responded that "there is a lot of difference in image", 20 people answered that "there is slight difference", and 7 peop le responded that "there is no difference". It was statistically significant ($p < 0.27$). F or hospital experience, the most responses were given by those with more than 7 yea rs of experience. were not statistically significant ($p < 0.55$). Regarding CT room exp erience, for people with over 7 years of experience, 17 responded that 'there is a lot of difference in image', 20 people answered that 'there is slight difference', and 2 peo ple responded that 'there is no difference'. However, it was not statistically significant ($p < 0.55$). Regarding shift type, respondents who only worked in CT rooms showed higher response rate than those who worked in other rooms. and were statistically si gnificant. ($p<0.11$), (Table. 1).

Table 1. Recognition level result of image difference according to CT baseline

Separated		There is a lot of radiation imaging differences.	Radiation imaging Differences are slight.	There is no radiation imaging difference.	et cetera	$\chi 2$	p-value
Sex	Male	41	69	18	1	1.409	0.73
	female	10	15	5	1		
Age	20 year	18	38	7	0	11.003	0.27*
	30 year	18	20	7	1		

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	40 year	12	17	4	0		
	50 year	3	9	5	1		
Hospital career	1 year	3	10	3	0	9.364	0.67
	1~3 year	14	20	4	0		
	3~5 year	6	17	3	1		
	5~7 year	4	5	4	0		
	7year	24	32	9	1		
CT Room career	1 year	7	20	9	0	20.670	0.55
	1~3 year	16	32	5	0		
	3~5 year	9	5	5	1		
	5~7 year	2	7	2	0		
	7year	17	20	2	1		
Working form	CT room only	24	48	8	0	5.925	0.11*
	Other part	27	36	15	0		
1year: Less than 1year, 1~3 year Group: 1 and Below 3 year Group, 3~5 year Group: 3 and Below 5 year Group, 5~7 year Group: 5 and Below 7 year Group p<.0.5*, p<0.1**, p<0.01***							

Recognition level result according to the difference in diagnostic range according to CT baseline

Recognition level results according to difference in diagnostic range according to the CT baseline were as follows. Eighty-one men and 22 women responded that “diagnostic range varies according to baseline”. Forty-one men and five women responded that “diagnostic range should not vary”. In addition, 7 men and 4 women responded that they were “uncertain”. and were statistically significant ($p < 0.11$). Regarding hospital experience, for those with 7 years or more, “diagnostic range varies” was the most frequent response (n = 35), followed by “there is no difference” (n = 28) and “uncertain” (n = 1). and were not statistically significant ($p > 0.59$). Regarding CT room experience, for those with 1 year or more but less than 3 years of experience, 39 responded that “diagnostic range varies”, 10 responded that “it should not vary”, and 4 responded “uncertain”. It was statistically significant ($p < 0.14$). Regarding CT room shift type, 52 responded that “diagnostic range varies” and 19 responded that “there is no difference in diagnostic range” among respondents who were working in unison with other parts. They responded more than those who worked exclusively in CT rooms. and were statistically significant (p<0.34), (Table. 2).

Table 2. Recognition level result according to the difference in diagnostic range according to CT baseline

Separated		The diagnostic range is different.	There is no difference in diagnostic scope	et cetera	$\chi 2$	p-value
Sex	Male	81	41	7	4.422	0.11*
	female	22	5	4		
Age	20 year	45	12	6	7.178	0.30*
	30 year	29	15	2		
	40 year	18	12	3		

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	50 year	11	7	0		
Hospital career	1 year	11	4	1	14.999	0.59
	1~3 year	28	7	3		
	3~5 year	20	3	4		
	5~7 year	9	4	0		
	7year	35	28	3		
CT Room career	1 year	24	8	4	12.089	0.14*
	1~3 year	39	10	4		
	3~5 year	14	5	1		
	5~7 year	6	4	1		
	7year	20	19	1		
Working form	CT room only	51	27	4	2.121	0.34*
	Other part	52	19	7		
1year: Less than 1year, 1~3 year Group: 1 and Below 3 year Group, 3~5 year Group: 3 and Below 5 year Group, 5~7 year Group: 5 and Below 7 year Group p<.0.5*, p<0.1**, p<0.01***						

Recognition level result regarding the unification of medical institutions using CT b aseline

Results of recognition level for CT baseline regarding unification of medical institutions are as follows. For gender, 35 men and 6 women responded “CT baseline of all medical institutions should be identical”, 44 men and 11 women responded “It is good to be standardized, but it doesn’t have to be identical”, 24 men and 7 women responded “It should be different for each patient”, and 26 men and 7 women responded that "it should be set according to the medical institution". It was not statistically significant ($p > 0.92$). In the case of hospital experience, for those with 7 years of experience or more, 19 answered that “CT baseline should be identical”, 26 responded that “it doesn't have to be identical”, 7 responded that “it should be different for each patient”, and 13 responded that “it should be set appropriately for each medical institution”. Those with over 7 years of experience had the most responses and was statistically significant ($p < 0.2$). Regarding CT experience, for those with 7 years of CT experience or more, 19 responded that “CT baseline should be identical”, 26 responded that “it doesn't have to be identical”, 7 responded that “it should be different for each patient”, and 13 responded that “it should be set according to medical institution”. and it was statistically significant ($p < 0.14$). Regarding CT room shift type, among respondents who were working in CT rooms and other rooms at the same time, 28 responded that “CT baseline should be identical”, 25 responded that “it doesn't have to be identical”, and 12 responded that “it should be different for each patient”. and it was statistically significant ($p<0.01$), (Table. 3).

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Table 3. Recognition level result regarding the unification of medical institutions using CT baseline

Separated		The CT baseline should be the same	CT baselines are not necessarily the same	Each patient should be different.	It should be tailored to the medical institution.	$\chi 2$	p-value
Sex	Male	35	44	24	26	0.921	0.92
	female	6	11	7	7		
Age	20 year	17	20	12	14	7.630	0.81
	30 year	11	15	12	8		
	40 year	10	13	4	6		
	50 year	3	7	3	4		
Hospital career	1 year	4	4	5	1	20.460	0.20*
	1~3 year	7	14	7	9		
	3~5 year	9	7	7	4		
	5~7 year	2	4	5	2		
	7year	19	26	7	13		
CT Room career	1 year	7	10	14	3	21.814	0.14*
	1~3 year	15	16	8	13		
	3~5 year	3	10	2	4		
	5~7 year	2	4	5	2		
	7year	19	26	7	13		
Working form	CT room only	13	30	19	0	11.741	0.01***
	Other part	28	25	12	0		
1year: Less than 1year, 1~3 year Group: 1 and Below 3 year Group, 3~5 year Group: 3 and Below 5 year Group, 5~7 year Group: 5 and Below 7 year Group p<.0.5*, p<0.1**, p<0.01***							

Recognition level results regarding the identical treatment of Brain CT and Brain MRI baseline

Recognition levels with identical treatment of Brain CT and Brain MRI baseline are shown as follows. Twenty-eight men and 12 women responded that “CT baseline and MRI baseline should be identical”, 57 men and 11 women responded that “It is good to be standardized, but it doesn’t have to be identical”, 13 men and 3 women responded that “it should be left to the choice of medical institution”, 31 males and 5 females answered that “it does not need to be identical”. and were statistically significant ($p < 0.25$). In the case of hospital experience, for those with 7 years of experience or more, 20 responded that "CT baseline and MRI baseline should be identical", 28 responded that "it doesn't have to be identical", 9 responded that “it should be left to the choice of medical institution”, and 9 responded that “it does not need to be identical”. For the group with over 7 years of experience, most participants responded, and was statistically significant ($p < 0.39$). Regarding CT room experience, for those with 7 years of experience or more, 12 responded that “CT baseline and MRI baseline should be identical”, 19 responded that “It doesn’t have to be identical”, 6 responded that “it should be left to the choice of medical institution”, and 3 had miscellaneous opinions. The group of subjects with

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over 7 years of experience had the highest response rate. and was statistically significant ($p <$ 0.39). Regarding CT room shift type, of respondents who were working in CT rooms and with other rooms at the same time, 23 answered that “CT baseline and MRI baseline should be identical”, 32 responded that “it doesn't have to be identical”, and 10 responded that “it should be left to the choice of medical institution”. and it was statistically significant. (p<0.18), (Table. 4).

Table 4. Recognition level results regarding the identical treatment of Brain CT and Brain MRI baseline

Separated		The CT baseline should be the same	CT baselines are not necessarily the same	Each patient should be different.	It should be tailored to the medical institution.	$\chi 2$	p-value
Sex	Male	28	57	13	31	4.034	0.25*
	female	12	11	3	5		
Age	20 year	15	29	4	15	12.83	0.17*
	30 year	9	17	4	16		
	40 year	12	14	5	2		
	50 year	4	8	3	3		
Hospital career	1 year	5	6	0	5	12.630	0.39*
	1~3 year	7	16	2	13		
	3~5 year	7	11	3	6		
	5~7 year	1	7	2	3		
	7year	20	28	9	9		
CT room career	1 year	12	11	3	10	12.684	0.39*
	1~3 year	10	25	3	15		
	3~5 year	4	9	2	5		
	5~7 year	2	4	2	3		
	7year	12	19	6	3		
Working form	CT room only	17	36	6	0	4.816	0.18*
	Other part	23	32	10	0		
1year: Less than 1year, 1~3 year Group: 1 and Below 3 year Group, 3~5 year Group: 3 and Below 5 year Group, 5~7 year Group: 5 and Below 7 year Group p<.0.5*, p<0.1**, p<0.01***							

Discussion

With the introduction of CT developed by Hounsfield in 1967 to the Department of Radiology, diagnosis of head disorders was significantly advanced. After that, in 1980, MRI was developed and introduced into clinical practice. As a result, various and accurate tests for head diseases have been carried out [2]. However, in the case of CT or MRI, since characteristic aspects and cross-sectional examination methods are different, it is difficult to determine which equipment is superior by comparing their advantages and disadvantages [7]. One research paper stated that "CT showed a high incidence of abnormal findings in patients with localized seizures or focal EEG findings, and MRI showed high incidence of abnormal

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findings in patients with systemic seizures or genuine EEG findings" [8]. As a result of exploring baseline brain CT of each medical institution in the present study, the result was OML 52, IOML 41, SOML 31, AC-PC Line 15, and 21 different for each patient. Baseline of brain CT is not presented. If the baseline is different, there could be a big difference between the image and exposure dose. One research reported that “In the case of 120 kV, when SOML was used as baseline, the dose of the correcting agent decreased by 85.08% compared to the IOML standard, and in the case of 80 kV, when SOML was used as the baseline, the dose to the lens was decreased by 79.7% compared to when IOML was used as the baseline” [9]. In the present study, results of recognition level survey on difference in image according to examination baseline, respondents who worked exclusively in the CT room recognized that there was a change in the image according to examination baseline ($p < 0.11$). Regarding hospital experience and CT room experience, respondents did not show statistically significant results, indicating that their recognition level was lower ($p > 0.73$). In addition, as a result of exploring the recognition level about difference in diagnostic range according to the baseline, it was recognized that there was a difference in the diagnostic range according to gender, CT room work experience, and shift type ($p < 0.11$). It can be said that it is important to unify the baseline during brain CT examination as there are differences in radiation exposure dose, diagnostic range, and image according to baseline. It has been suggested that for TS-EOP and TS-IOP, baseline of brain CT should be the same baseline as the AC-PC Line, the baseline of Brain MRI [4]. In the present study, based on results of the recognition level for the unification of baseline of brain CT according to medical institution, hospital experience, CT room experience, and shift type, it was found that respondents recognized that unification should be performed ($p < 0.01$). In addition, results of recognition level survey on the unification of baseline of brain MRI and brain CT according to gender, age, hospital experience, CT room experience, and shift type revealed that respondents recognized that it should be unified ($p < 0.17$). In this study, many respondents recognized that baselines of medical institutions should be unified, baselines of brain MRI and brain CT should be identified, and a unified baseline of Brain CT should be presented.

Conclusion

As a result of studying the recognition level of the examination baseline during brain CT, the following conclusions were obtained. In each medical institution, baselines for Brain CT

were found to be different: OML (n = 52), IOML (n = 41), SOML (n = 31), and AC-PC Line (n = 15). It was found that the recognition level of image differences according to CT baseline was insufficient ($p > 0.73$).

The difference in the diagnostic range according to CT baseline was found to be recognized as having a difference according to diagnostic range except for in hospital experience ($p > 0.59$) ($p < 0.11$). As a result of the recognition level for the unification of the baseline of brain CT in medical institutions, it was found that respondents recognized that unification should be performed according to hospital experience, CT room experience, and shift type ($p < 0.01$). In a recognition level survey on the unification of baselines of brain MRI and brain CT, it was found that all respondents recognized that it should be unified ($p < 0.17$). Therefore, baseline of brain CT should be re-established and a unified baseline should be presented.

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