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Possibilities of Reducing Radiation Dose in Computed Tomography Examinations in Various Age Groups Using an Iterative Model-Based Reconstruction Technique

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Abstract

Aim: To determine whether iterative model-based reconstruction (IMR) technique can preserve computed tomography (CT) image quality when the radiation dose is reduced to 20% of the original value.

Methods: CT examination of the neck, mediastinum, or stomach was performed using standard protocols with a Philips Healthcare MDCT 64. Fifty imaging studies were evaluated. The patient's set was divided into three groups: Young, Preadolescent, and Adult. Four experienced evaluators assessed the CT scans reconstructed using filtered back projection (FBP) and IMR technique (using the L1BR, L2BR, and L2BSP levels) at a 100% dose and at a dose reduced by 80%. The dose was reduced by a decrease in milliampere seconds (mAs). Image noise, artifacts, anatomical details, sharpness, low-contrast resolution, general impression of the reconstructed image, possibility of influencing the description, and possibility of influencing the examination's conclusion were assessed. FBP at 100% of mAs was always used as the basis for comparison. Decrease in a parameter meant a negative point score while an improvement was marked as positive. Subsequently, objective measurement of image quality was also performed.

Results: The greatest improvement in image quality (relative to the quality of images reconstructed using FBP with 100% dose) was achieved using IMR L2BR reconstruction, which can be recommended as optimal. The IMR L2BR reconstruction method was statistically demonstrated to have the best performance among the tested methods in suppressing noise and artifacts. In relation to the selected indications, this method allows a reduction in dose by as much as 80%. The effect of IMR was less marked among the youngest patients than in the remaining two patient groups.

Conclusion: The study demonstrated that use of the IMR technique preserves diagnostic indications even with a markedly reduced dose in CT examinations of the neck, thorax, and abdomen in various age groups.

Keywords: CT examination; Filtered back projection; Iterative reconstruction technique; Noise; Radiation dose reduction

Abbreviations:

BR: Body Routine; BSP: Body Sharp Plus; CT: Computed Tomography; CTDI: Computed Tomography Dose Index; FBP: Filtered Back Projection; iDOSE: Hybrid Iterative Reconstruction; IMR: Iterative Model-Based Reconstruction; MDCT: Multidetector Computed Tomography

Introduction

The collective dose from medical radiation has been sharply increasing. As of 2009, there had been a sevenfold increase as compared to 1980 (according to the United States' National Council on Radiation Protection and Measurements). This trend has also been recorded in the Czech Republic, albeit not as markedly as in the U.S. Irradiation of the population from computed tomography (CT) examinations is increasing and comprises approximately 30% of the radiation burden from all radiodiagnostic methods [1]. The average dose from medical irradiation in the Czech Republic is 1 mili-Sievert (mSv) per year [2]. The radiation burden in examinations performed on multidetector CT (MDCT) devices is higher compared to that from using CT devices of the previous generation. The radiation burden for organs (kidneys, uterus, ovaries, pelvic bone marrow) is 92-180% higher [3,4]. The stated values of effective doses are, for example, 2.3 mSv for one cranial CT, 8 mSv for one thoracic CT, and 10 mSv for one abdominal or pelvic CT [5].

According to data published by the International Atomic Energy Agency, children are up to 10 times more sensitive to ionizing radiation than are adults. This is due to the facts that children have more immature cells and, because of low doses and therefore stochastic effects, longer life expectancies [6,7]. Such tissues as bone marrow or brain tissue are highly radio-sensitive, and especially so in childhood. A retrospective study published in 2012 by Pearce et al. [8] focusing on the impact of ionizing radiation during CT examination in childhood confirmed increased risk of leukemia or brain tumor. The problem stems from repeated examinations using ionizing radiation whereby the probability of damage from the individual examinations is compounded regardless of the time passed between them [6].

The principles of reasoning and optimization are applied in regulating medical radiation [1]. The indicating physician must consider whether the given examination can be replaced by another which does not subject the patient to the effects of ionizing radiation [6,9]. For children, ultrasound or magnetic resonance examinations are preferred whenever possible. Based on an orientation examination in Great Britain, experts have estimated that up to onethird of CT examinations could have been replaced with an alternative form [1]. Optimization means that the dose must be the minimum required to obtain high-quality diagnostic information [6]. This is referred to as the ALARA (as low as reasonably achievable) principle [2,10].

The CT dose is significantly influenced by selection of the correct examination protocol, comprising the setting of parameters critical for the patient's dose: X-ray tube voltage, current, time, pitch factor, and general collimation [6]. Some medical institutions create protocols for children according to age [3,11]. Many others, including ours, create CT examination protocols for children according to weight. Similar protocols for MDCT examination of children including dose length product have been published, for example by Debbie and Kerry [3,12]. Using lower kilovolts in pediatric protocols markedly reduces the radiation burden. The topic of examination protocols with decreased voltage also has been studied by Siegelová et al. [3,13]. Changing the topogram orientation from anterior-posterior to posterior-anterior and using exposure automation and current modulation also help to decrease the patient dose. Reducing the milliampere seconds (mAs) provides a much noisier image but one still evaluable for certain diagnoses. A further reduction in the radiation burden can be achieved by using iterative reconstruction techniques, which suppress noise and therefore make possible examinations at lower values of the Kerma computed tomography dose index (CTDI) [6].

Iterative reconstruction technique was already applied by the very first CT devices in the 1970s. It was subsequently replaced by analytical methods, specifically filtered back projection (FBP). The rapid development of computing technology in recent years has again allowed the implementation of iterative reconstruction principles in reconstructive CT algorithms [2].

In 2012, we tested the statistical hybrid iterative reconstruction technique iDose4 (Philips Healthcare, Best, Netherlands) in CT brain examinations in children, adolescents, and adults [3]. In the next stage, during 2013-2015, we tested the iterative model-based reconstruction (IMR) technique (Philips Healthcare, Best, Netherlands) in patients ranging from newborns to adults. In our study, we decreased mAs values to around 20% of the original value and sought answers to several questions, namely whether CT scans reconstructed using the IMR technique would be usable for diagnostics, when their use would be possible, which of the IMR levels would be the most suitable for common use, and which of the evaluated parameters would be most affected by the IMR reconstruction method. We were also interested in whether the results would be the same in all age groups.

Materials and Methods

This study, approved by the Ethical Commission of the University Hospital Brno (reference number 1332013), was performed in accordance with the Declaration of Helsinki and all patients gave their written informed consent.

During 2013-2015, possibilities for using the IMR technique were tested at our institution (IMR Prototype, Philips Healthcare, Best, Netherlands). Thereafter, 50 image studies (30 boys and 20 girls) divided into three groups (Young - 10 studies, Preadolescent - 25 studies, Adult - 15 studies) were selected for detailed statistical processing. The average ages in the individual groups were 4.45 months, 5.9 years, and 29.4 years, respectively. Patients' ages ranged from 0.5 month to 48 years.

Native and post-contrast CT examination of neck (2×), thorax (31×), or abdomen (17×) areas was performed in patients while following standard protocols established according to patients' weight. We used protocols with collimation 64 × 0.625 mm, rotation time 0.5-0.75 s, pitch 0.671-0.891, tube voltage 80-120 kV, and wide current range (35-207 mAs) using Z-DOM current modulation on the Philips Healthcare MDCT 64 device. CT scans were reconstructed using FBP and IMR with several different levels. In 32 studies, this was followed by a series with the mAs reduced to a value ranging around 20% of the original value (average mAs reduction value was at 23.38%, which correlated with the value of CTDI vol reduction where the average reduction value was at 20.6%) and with CT scans reconstructed in the same way. In the case of these 32 studies, native examination was conducted with a reduced mAs value in order to prevent an increased total standard dose for examination.

Of the tested IMR levels from the softest to the sharpest (body soft, body routine, body sharp plus), L1BR, L2BR, and one "sharp" L2BSP were preselected as the most suitable. For scans with non-reduced dose, levels L1BR and L2BR were always used while level L2BSP was used in 34 cases. For reduced-dose scans, levels L1BR and L2BR were always used while level L2BSP was used in 21 cases.

Frames for evaluating the mediastinum (W: 350, L: 50) and stomach (W: 360, L: 60) were used to evaluate image documentation. Images with slab width of 3 mm were evaluated on the ISP client station (Philips Intellispace Portal, Best, Netherlands).

The resulting images obtained by reconstruction using the IMR technique were compared with those images obtained by reconstruction using the FBP method, both for normal dose and for a dose reduced to 20%. The evaluation was performed both subjectively and objectively.

Four experienced radiologists independently evaluated and rated image noise, image artifacts, anatomical detail, sharpness, low-contrast resolution, total impression of the reconstructed image, possibility of influencing the description, and possibility of influencing the examination's conclusion.

We used an adapted 5-point Likert scale ranging from −5 points to +5 points, wherein the value of image parameters reconstructed using FBP at a 100% dose always had a value of 0 points. Improvement in an individual evaluated parameter was indicated by positive points while deterioration was shown by negative points. The points scale was defined as follows: FBP 100%: 0 points; −5 points: practically unevaluable; −4 points: difficult to evaluate; −3 points: noticeable parameter deterioration; −2 points: slight parameter deterioration; −1 point: very slight parameter deterioration; 1 point: very slight parameter improvement; 2 points: slight parameter improvement; 3 points: noticeable parameter improvement; 4 points: considerable

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parameter improvement; 5 points: highly considerable parameter improvement.

Statistical analysis requires a single value of the quality score for a given data reconstruction. Such value was obtained as the mean value calculated among the medical experts. Mean values of subjective evaluations in individual groups are visualized using heat maps (Figure 1), where a value of 0 (reference quality of FBP reconstruction with 100% applied dose) is indicated by white while negative or positive values (lower/higher image quality) are colored red or green, respectively, according to the color bars on the right-hand side of each heat map. Heat map visualization reveals relationships between types of reconstructions, patient groups, and evaluated quality parameters. The visualization helps to establish the hypotheses to be tested by the procedure described in the following paragraph.

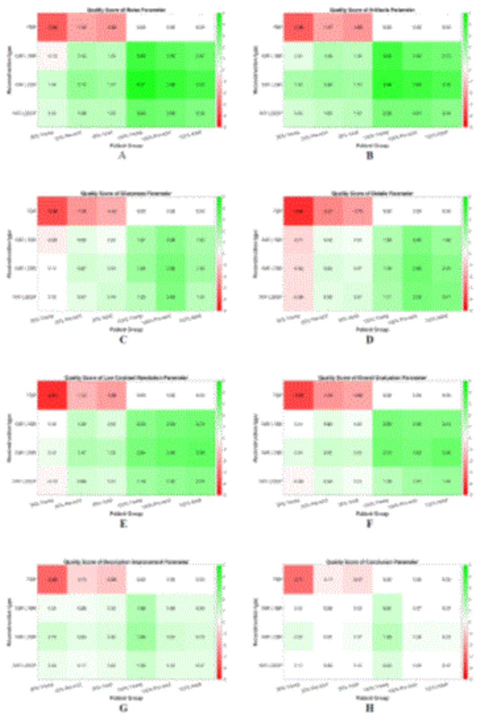

Figure 1: Heat maps visualizing mean values of subjective medical quality evaluations by individual patient group and reconstruction type for each evaluated image quality parameter: A: Noise; B: Artifacts; C: Sharpness D: Details; E: Low-contrast resolution; F: Overall evaluation; G: Description improvement; G: Conclusion.

Many statistical tests (e.g., between patient groups, depending on the particular hypothesis formulation) must be conducted to confirm that the mutual relationships revealed by visual inspection of Figure 1 are statistically significant. We used the Wilcoxon rank-sum test, which is suitable for testing a null hypothesis stating that two tested groups of subjective evaluations are samples from a distribution with equal medians against the alternative that they are not. A positive test result (labeled by a 1) indicates rejection of the null hypothesis at the 5% significance level and acceptance of the alternative hypothesis (medians of the tested groups are not equal). A negative result (labeled by a 0) indicates failure to reject the null hypothesis at the 5% significance level (medians of the tested groups are equal). If the difference between group medians is statistically significant, then the medians are compared and a higher or lower median is further labeled green or red, respectively. Whether the subjective quality evaluation in a certain group is significantly lower or higher than in another group is thus determined and a hypothesis can be rejected or accepted.

Based on visual inspection of Figure 1, IMR L2BR reconstruction always provides data with the greatest improvement in image quality with respect to FBP reconstruction with a 100% dose. Hypothesis 1 is thus formulated to be able mutually to compare subjective quality evaluation of IMR L2BR reconstruction with the other tested reconstruction types.

Hypothesis 1 states the following: Data reconstructed using IMR L2BR have the highest subjective quality evaluation (tested for each patient group and each subjectively evaluated quality parameter).

To accept or reject Hypothesis 1, subjective evaluations of data reconstructed using the IMR L2BR algorithm are tested against data for the other reconstruction types within corresponding patient groups and corresponding image quality parameters.

The goal of testing Hypothesis 2 is to find out for which subjectively evaluated quality parameter IMR L2BR reconstruction has the best performance (i.e., for which subjective image quality parameter is the evaluation, and thus improvement in image quality with respect to FBP reconstruction with a 100% dose, highest). According to Figure 1, the IMR L2BR algorithm shows the best performance in reducing noise. Subjective evaluations of selected technical parameters (parameters influenced by the physics of the acquisition process - artifacts, sharpness, details, low-contrast resolution) are thus compared with evaluation of the noise parameter in a similar manner as in the previous case.

Hypothesis 2 states the following: IMR L2BR reconstruction has the best performance in noise suppression (tested against selected technical quality parameters for each patient group).

A careful reader may notice an interesting paradox when visually comparing subjective image quality evaluations among patient groups in Figure 1. Considering FBP reconstructions, subjective quality evaluations of data from the patient group 20% Young are always lower than are quality evaluations from groups 20% Preadolescent and 20% Adult. On the other hand, it seems that data reconstructed using IMR L2BR exhibit the highest evaluations in the group 20% Young in relation to the quality parameters Description improvement and Conclusion but the lowest evaluations in relation to the other quality parameters. The goal of Hypothesis 3 is to compare evaluations among age groups and to determine whether or not the aforementioned paradox is statistically significant. Hypothesis 3 is formulated so as to compare subjective evaluations for the age groups 20% Preadolescent and 20% Adult with those for the age group 20% Young for the two selected reconstruction methods (FBP and IMR L2BR) and each evaluated quality parameter.

Hypothesis 3 states the following: The data for the Young patient group have higher subjective evaluation medians for a given quality parameter than do identically reconstructed data for the Adult and Preadolescent groups (tested only on images acquired with a 20% dose and reconstructed by algorithms IMR L2BR and FBP).

In addition to subjective medical evaluation, an objective image quality measurement was performed and compared with the subjective evaluation. As a factor crucial for image quality, image noise was chosen for objective measurement represented by local variance of

Hounsfield units in homogeneous image sections. Calculation of local Hounsfield units variance is based on the following procedure: In order to evaluate image noise only in parts of data containing human tissues, surrounding air must be eliminated. This is achieved by simple thresholding using a threshold determined by Otsu's method [14] followed by a filling algorithm based on morphological reconstruction [15]. Local variance is an appropriate measure of image noise content, but it is reliable only in homogeneous image sections away from edges, where the local variance reflects rather the edge structure than the degree of image noise. Homogeneous image sections are thus detected in the next step. Local variances in a 3 × 3 pixel-sized sliding window are calculated and thresholded with a threshold optimally determined such that 50% of voxels with the highest homogeneity are left (edges are thus removed). The median of local variances in such determined homogeneous image sections serves as a measure of image noise. As the subjective medical quality evaluations are determined relative to FBP reconstruction with a 100% dose, the median of local variance is accordingly recalculated. Median of local variance in homogeneous body parts for a given reconstruction type is recalculated as a percentage, taking the median of local variance for FBP reconstruction with a 100% dose as 100% of image noise content.

Results

The interobserver agreement as represented by Pearson's correlation coefficient calculated among medical experts is high (0.9-0.953).

Results from testing Hypothesis 1 are summarized in Table 1. How to read the table may be best explained by example: The green 1 in the cell where row two and column three intersect indicates that the median of subjective noise evaluations of data from patient group 20% Young reconstructed by IMR L2BR is higher by a statistically significant amount than is the median of data from the same group reconstructed by FBP. Based upon these results, it can be concluded that the greatest improvement in image quality with respect to quality of FBP reconstruction with 100% dose is always achieved with IMR L2BR reconstruction, which can thus be recommended as the optimal choice for the best quality CT image reconstruction among the tested algorithms. Considering the quality parameters Sharpness and Details, IMR L2BSP reconstruction type has, in several patient groups, slightly higher median than does IMR L2BR, but these differences are not statistically significant.

Quality Parameter	Reconstruction type	20% Young	20% Preadol.	20% Adult	100% Young	100% Preadol.	100% Adult
Noise	FBP	1	1	1	1	1	1
	IMR L1BR	1	1	0	1	1	1
	IMR L2BSP	0	1	0	1	1	1
Artifacts	FBP	1	1	1	1	1	1
	IMR L1BR	1	1	0	0	1	1
	IMRL2BSP	1	1	0	1	1	1
Sharpness	FBP	1	1	1	1	1	1
	IMR L1BR	0	1	1	0	1	0
	IMRL2BSP	0	0	0	0	0	0
Details	FBP	1	1	1	1	1	1
	IMR L1BR	0	1	1	0	0	0
	IMRL2BSP	0	0	0	0	0	0
Low-contrast resolution	FBP	1	1	1	1	1	1
	IMR L1BR	0	1	1	0	1	1
	IMRL2BSP	0	1	0	0	1	1
Overall evaluation	FBP	1	1	1	1	1	1
	IMR L1BR	0	1	1	0	1	1
	IMRL2BSP	1	1	1	1	1	1
Description improvement	FBP	1	1	1	1	1	1
	IMR L1BR	1	1	1	0	1	1
	IMRL2BSP	0	1	0	1	1	0
Conclusion	FBP	1	1	1	1	1	1

	IMR L1BR	1	0	1	1	1	1
	IMRL2BSP	0	0	0	1	1	1

Table 1: Results from statistical testing of Hypothesis 1 comparing subjective evaluations of IMR L2BR reconstruction with the other reconstruction algorithms by patient group and evaluated quality parameter. Zeros indicate no statistically significant difference existing between group medians, whereas red/green 1s indicate a statistically significant lower/higher group median compared to the median of the corresponding group reconstructed by IMR L2BR.

Results from the comparisons are summarized in Table 2 and show that most of the time there are no statistically significant differences between subjective evaluations of the parameters Noise and Artifacts. Meanwhile, differences between the Noise parameter and the rest of the selected technical parameters are statistically significant (whereas subjective evaluation of the Noise parameter is higher by a statistically significant amount). It can be concluded that IMR L2BR reconstruction has the best performance among the tested image quality parameters in reducing image noise and artifacts.

Quality Parameter	20% Young	20% Pre-adol.	20% Adult	100% Young	100% Pre-adol.	100% Adult
Artifacts	0	0	0	0	1	0
Sharpness	0	1	1	1	1	1
Details	1	1	1	1	1	1
Low-contrast resolution	0	1	1	1	1	1

Table 2: Results from statistical testing of Hypothesis 2 comparing the quality parameter Noise with other selected technical parameters by patient group and for IMR L2BR reconstruction type. Zeros indicate no statistically significant difference existing between group medians, whereas red/green 1s indicate a statistically significant lower/higher median compared to the median of the Noise parameter.

The results of testing Hypothesis 3 are summarized in Table 3. Here, for example, the red 1 in the cell where row two and column three intersect indicates that the median of subjective noise evaluation of data from patient group Young 20% reconstructed by FBP is lower by a statistically significant amount than is the median of evaluation of identically reconstructed data from the group Preadolescent 20%. Considering only the results for the FBP reconstruction method for each evaluated quality parameter, data relating to the Young 20% age group have statistically significantly lower subjective evaluation than do data of the Preadolescent 20% and Adult 20% age groups. Considering the results for IMR L2BR reconstruction, in the Preadolescent 20% group, the technical quality parameters (Noise, Artifacts, Sharpness, Details, Low-contrast resolution) have, with statistical significance, higher evaluations than in the Young 20% group; however parameters related to medical diagnosis (Description improvement and Conclusion) have evaluations lower by statistically significant amounts. Considering evaluations from the Adult 20% group, similar results may be observed with the technical parameters Noise, Details, and Low-contrast resolution and the diagnostically based Conclusion parameter. The aforementioned paradox may thus be considered statistically significant. Based on these results, it can be concluded that IMR L2BR reconstruction provides substantial greater diagnostic outcome with respect to data of very young patients compared to older patients and this phenomenon cannot be observed while using the FBP reconstruction method. IMR L2BR reconstruction is unable to improve technical image quality (suppress noise, remove artifacts, etc.) of data for very young patients when using the dramatically reduced dose to the same degree as in data for older patients. Nevertheless, the outcome for improving medical diagnosis is in this age group much greater.

		Noise	Artifacts	Sharpness	Details	Low-Contrast Resolution	Overall Evaluation	Description Improvement	Conclusion
FBP	Pre-adolescent	1	1	1	1	1	1	1	1
	Adult	1	1	1	1	1	1	1	1
IMR L2BR	Pre-adolescent	1	1	1	1	1	1	1	1
	Adult	1	0	0	1	1	0	0	1

Table 3: Results from statistical testing of Hypothesis 3 comparing evaluations from group 20% Young with evaluations from groups 20% Preadolescent and 20% Adult for reconstruction algorithms FBP and IMR L2BR and all quality parameters. Zeros indicate no statistically significant difference existing between group medians, whereas red/green 1s indicate a statistically significant lower/higher median compared to the median of the noise parameter/reference group.

Figure 2 shows the heat map of relative objective noise measurement (median of local variances in homogeneous body parts) calculated according to the procedure described in the Materials and Methods. Based on visual comparison of Figures 1a and 2, it can be stated that the results of subjective medical evaluation of the Noise parameter and objective noise measurement are very similar. Subjective medical noise evaluation thus corresponds to objective noise measurement as represented by the median of local variances calculated in homogeneous image parts.

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Figure 2: Heat map visualizing medians of percentage objective relative quality scores by individual patient group and reconstruction type for the Noise parameter.

Figure 3 demonstrates the possibility to improve image quality using IMR L2BR reconstruction (as compared to FBP reconstruction) at a 100% dose and with a dose reduced to 20% of the original value.

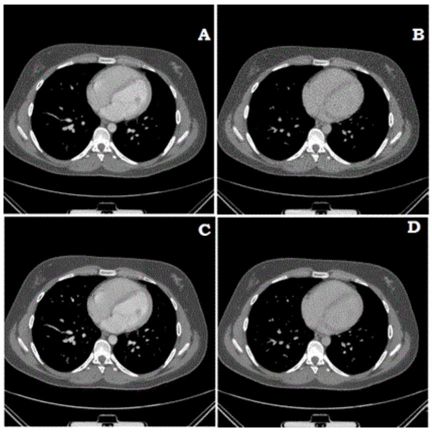

Figure 3: CT scans reconstructed with FBP at (a) 100% dose and (b) 20% dose and with IMR L2BR at (c) 100% dose and (d) 20% dose.

Discussion

The main advantage of iterative reconstructive methods is substantial decrease in the level of noise in the CT image, thereby allowing examinations to be performed with a reduced radiation dose. In connection with these methods, various authors have stated acceptable values of noise reduction and dosage whereby the possibility to reduce radiation dose is reported to be in the approximate range of 30-60% [2,16-19].

In 2012, the iDose4 (Philips Healthcare, Best, Netherlands) method was tested at our institution in examining the brains of children, adolescents, and adults. In this case, the dose was reduced by 30% [3]. Although reducing the dose by such amount brought a certain decrease in image quality, it also was demonstrated that the use of iDose4 fully compensated for this deterioration. We currently have this system installed on our CT device, and it does allow for a certain decrease of the dose. Due to the possible adverse effects of ionizing radiation, it is nevertheless necessary to continue being very careful and to give individual consideration of indication to CT examination, especially in children. The recent article by Lambert et al. [20], who are focused on possibilities for using the hybrid iterative technique in the thorax area, is interesting in this connection.

In the second phase, we tested Philips Healthcare's more advanced IMR. This is a knowledge-based iterative model reconstruction. Tests performed on phantoms demonstrate the possibility of reducing noise and dose while also improving resolution at low contrast in comparison to FBP by as much as 80% when IMR is used and while reconstruction times come in under 3 min [21-23].

In our case, we decreased mAs (which is closely correlated with the value of CTDIvol) by ca 80% and studied IMR's capability for image improvement. Based on results of testing Hypothesis 1, it can be concluded that IMR L2BR reconstruction provides data with better image quality (for each evaluated image quality parameter) than do the other tested reconstruction types irrespective of patient's age. The effect of IMR appeared mainly in reduction of noise and artifacts (see the results for Hypothesis 2 in Table 2), whereas the subjective medicinal noise evaluation matched its objective measurement. In the smallest patients of newborn and infant age as compared to the other age groups, however, the results were poorer. In this patient group, CT scans are generally less sharp, less pronounced, and with a lower tissue contrast. These characteristics somewhat limit the possibility of improving image quality [3]. This also relates to the fact that examinations are performed under total anesthesia, and therefore in our conditions usually without an apneic pause. In this patient group, we paradoxically perceived the greatest benefit for potential modification of description or examination conclusion (see results for Hypothesis 3 in Table 3), because practically unevaluable examinations have been made diagnostically usable utilizing IMR.

A very recent article by Ryu et al. [24] reports the results of testing on pediatric phantoms and demonstrates that reduced-dose IMR obtained at 0.92 mSv (24%) produced similar image quality as did routine-dose FBP obtained at 3.64 mSv (100%). The great importance of iterative reconstruction techniques, one of which is IMR, in reducing the radiation dose in pediatric abdominal CT examinations has been demonstrated by Khawaja et al. [25]. A number of articles reporting upon the use of IMR in practice have recently been published, such as a paper by Park et al. [26], who studied the possibility to use IMR in diagnosing urolithiasis.

Based upon the available information, it appears that CT scans with markedly reduced doses and reconstructed using IMR could be used in practice where there are large differences in densities of the assessed structures, where the focus is only on basic anatomical relationships, in targeted reexaminations, in native examinations prior to admission of a contrast agent, and in certain other instances. This is especially important for child oncologic patients, in whose cases we presume a large proportion of reexaminations and monitoring examinations for which image technical quality is not a top priority. The same opinion has recently been published by a research team from Oregon Health and Science University, Portland, Oregon [23].

Concerning our work, interobserver agreement was high in all cases. A certain disadvantage, however, of images reconstructed using iterative reconstruction is that their appearance is subjectively perceived differently as compared to standard FBP images [2]. In our study, we observed this primarily to be the case in connection with the

L2BSP level. We can foresee the use of this level in cases of skeleton evaluation or lung HRCT rather than in evaluating soft-tissue structures, where the L2BR level proved to be the best.

Conclusion

The use of iterative model-based reconstruction improves the quality of CT images. This improvement is very substantial in the case of a large decrease of the mAs value to just 20% of the original value. In the youngest patient group, this improvement is less marked in comparison to that for the other age groups, but even in these cases the use of this technique is very beneficial.

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Competing Interests

Petr Ouředníček is an employee of Philips Healthcare. The other authors have no relevant financial relationships to disclose.

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