

Recommendations for Sonographers to Work Safely,
Comfortably and Healthfully

– Equipment and working environment to prevent
work-related musculoskeletal disorders and eyestrain —

- DIGEST -

The Japan Society of Ultrasonics in Medicine
Ultrasound Equipment and Safety Committee

Why are these recommendations issued now?

The reason why these recommendations come to be issued was musculoskeletal disorders in sonographers that come to an issue in UK. Musculoskeletal disorder is an injury or damage of muscles, skeletons, nerves, tendons, ligaments, joints, cartilages and intervertebral disks caused by overload due to task, including neck-shoulder-arm disorder and low back pain. It is important to clarify whether sonographers in Japan do also have musculoskeletal disorders, and what is the cause of the injuries, if they have. In addition, it is especially important to develop and practice countermeasures for sonographers to prevent musculoskeletal disorders so that they can work safely, comfortably, and healthfully.

The Japan Society of Ultrasonics in Medicine has set up Research and Development Team to work at "Ergonomic study on ultrasonic diagnostic equipment and examination environment for sonographers " under the Ultrasound Equipment and Safety Committee in the fiscal year 2010. Since then, the Research and Development Team has continued their efforts to develop the recommendation with energetically conducting investigation research activities with the support of other specialized institutions.

Results of investigation research

As the results from investigation research of the Research and Development Team, the following were revealed:

1. It was indicated that there are a certain number of sonographers who conduct examination works with experiencing musculoskeletal disorder such as neck-shoulder-arm disorder and low back pain.
2. It was indicated that working posture of sonographers causes a substantial workloads because of bending and twist of the body trunk, elevation of the upper arm, and no support of forearm and wrist. (See Figure below)
3. The reason that examination tasks are conducted working in a posture causing a substantial workloads seems to be that they engage the work without adequate consideration of the whole concept of ergonomic design of ultrasonic diagnostic equipment, the procedure of operation conducted by sonographers, and correlation between body types and positions of examinee.
4. Although work time per a day, rest time, continuous time on task before a rest etc. are various depending on facilities or sonographers, in general, attention to reduce the load seems inadequate. It is required to give appropriate consideration to work time per a day and distribution of work and rest time in the future.
5. Sonographers in many facilities are engaged on examination work with poor lighting in a limited examination room. It was indicated that such working environment increases workload of the sonographers furthermore.

Based on the above-mentioned research results, recently the Research and Development Team worked out this Recommendations for sonographers to Work Safely, Comfortably and Healthfully under the Ultrasound Equipment and Safety Committee. We hope that workload for sonographers will be reduced and the social value of ultrasonography will increase furthermore.

Trilateral cooperation is desirable

Target users of these recommendations include sonographers, managers of facilities conducting ultrasonography, and manufacturers and technology developers of ultrasonic diagnostic equipment. These recommendations are developed for these three parties, respectively; however, it is desirable that better manufacturing, environmental improvement of facilities, improvement of working conditions, and ergonomic education progress simultaneously, and activities to realize less straining, comfortable operation are conducted through combination and cooperation among these three parties.

Expectation for sonographers

- Acquisition of examination techniques that applied ergonomics and practice of light workload are required.

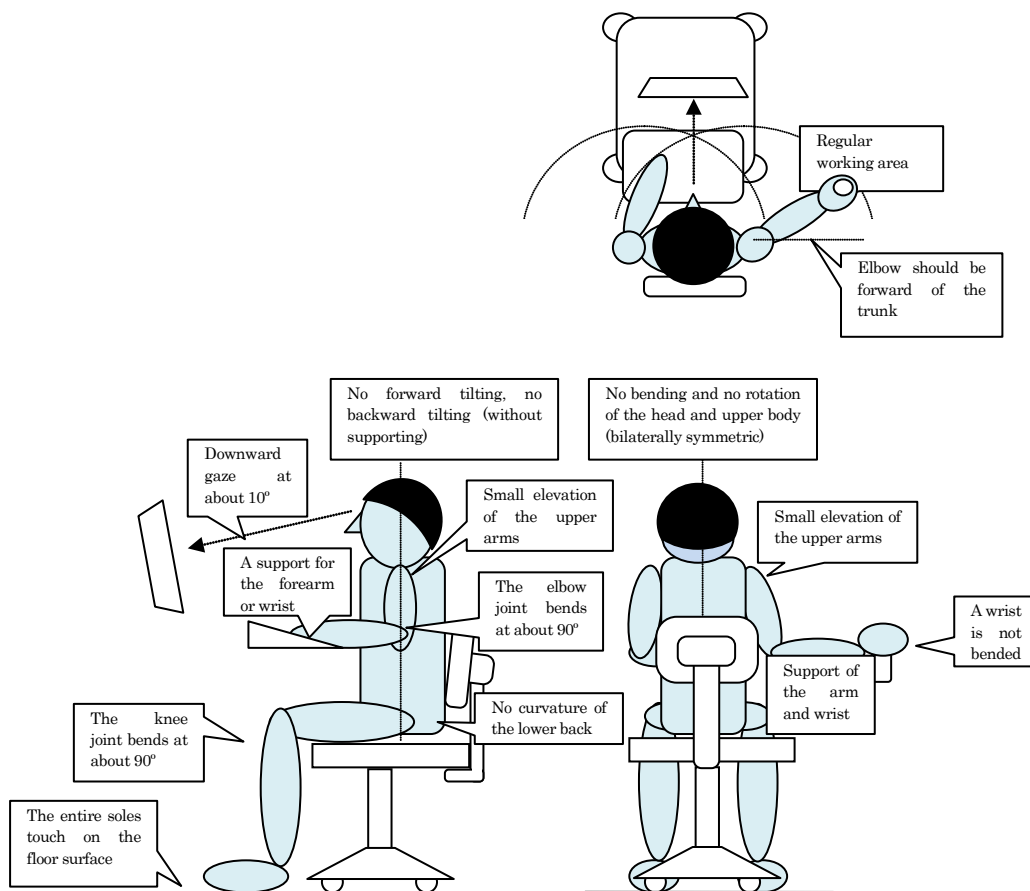
- Effort to reduce workload through improvement of workplace and voluntary participation in improvement activities are expected.

Expectation for managers of facilities conducting ultrasonography

- Provision of sufficient examination space and development of proper examination environment are expected.
- Appropriate amount of work and distribution of sufficient number of personnel as well as appropriate rest time are expected.

Expectation for manufacturers and technology developers of ultrasonic diagnostic equipment

- Development of equipment with due considerations to ergonomics including operability, visibility, and adaptability to examination environment condition is expected.
- Promotion of more integrated design of equipment, including an examining table, chair as well as the space of examination room, rather than independent design is expected.



A schematic diagram of an ideal posture for examination task to reduce workloads

Commitment of the Japan Society of Ultrasonics in Medicine

Role and commitment of the Japan Society of Ultrasonics in Medicine as an independent organization are important to realize safe, comfortable and healthy working environment. Diversified activities of the society are expected toward the realization of the recommendation.

- Human resource development at the initiative of the Japan Society of Ultrasonics in Medicine
- Consideration of evaluation methods regarding development of ergonomic environment by a third party organization in cooperation with other specialized institutions.
- Consideration of evaluation methods regarding ultrasonic diagnostic equipment by a third party

organization in cooperation with other specialized institutions.

This leaflet is a digest of the recommendation

"Recommendations for Sonographers to Work Safely, Comfortably and Healthfully - Equipment and working environment to prevent work-related musculoskeletal disorders and eye disorders -" that describes details of these recommendations is available on the web site of the Society (<http://www.jsum.or.jp/>). We hope that relevant parties go through these recommendations and put to practical use.

Recommendations for Sonographers

To prevent disorders caused by ultrasonography, it is needed to contrive to develop environment of examination rooms and diagnostic devices, the layout of associated equipment, and working procedures to change the posture of sonographers more natural and less straining as much as possible. It is necessary to develop procedure to avoid continuous unnatural posture as much as possible, and to avoid working more than one hour continuously. It is also effective to contrive to change the posture as much as possible during a long-lasting operation.

1. Frequently adjust the position of devices and equipment to avoid constrained posture

It is very important to frequently adjust the position of diagnostic devices, the position and height of a display and operation panel, the height of a chair, the position and height of an examining table so that sonographers can work in less-straining posture.

2. Avoid continuous work for long time

It is very important to avoid examination task with handling a probe more than one hour continuously. To achieve this, determine examination schedule to avoid continuation of postural strain for prolonged time by, for example, inserting rest time or other tasks.

3. Ask examinees to change their posture

To conduct high-quality examination in less-straining posture, ask examinees to change their position and posture.

4. Take measures to glare and make the room brighter insofar as a display is easily viewable

Adjust the room illuminance adequately. It is important that lighting equipment is adjustable so that display looks not too bright and the images are clearly viewable. Take measures including adjustment of the position and angle of the display, improvement of lighting equipment, and light shielding of windows to avoid glare caused by lighting in a room and to prevent bothersome light entering into the eye directly.

5. Improve posture and methods of working

Contrive working methods to avoid putting extra strength as much as possible. It is necessary to take care to improve and realize the working posture without workloads through conscious consideration of posture of yourself as well as colleagues.

6. Adjust displays readily viewable

In the cases of using a new ultrasonography, using transferred or newly built examination room, changed lighting condition, or changed layout, make sure whether brightness or contrast of the display are optimally adjusted.

7. Perform stretching exercises during an interval of examinations

Stretching exercise during an interval of examinations is effective to prevent musculoskeletal disorders.

8. Give extra consideration to risks other than ultrasonography

Tasks other than examination, especially transfer of examinees, are high-risk tasks. Examination procedure

should avoid transferring examinees as much as possible.

9. Make it a policy to maintain your health and physical strength

Because ultrasonography is a task to place a great physical workloads, it is important to make it a policy to maintain your health and physical strength in a good condition. Adequate rest and sleep is effective to conduct tasks safely and comfortably.

Recommendations for managers of facilities conducting ultrasonography

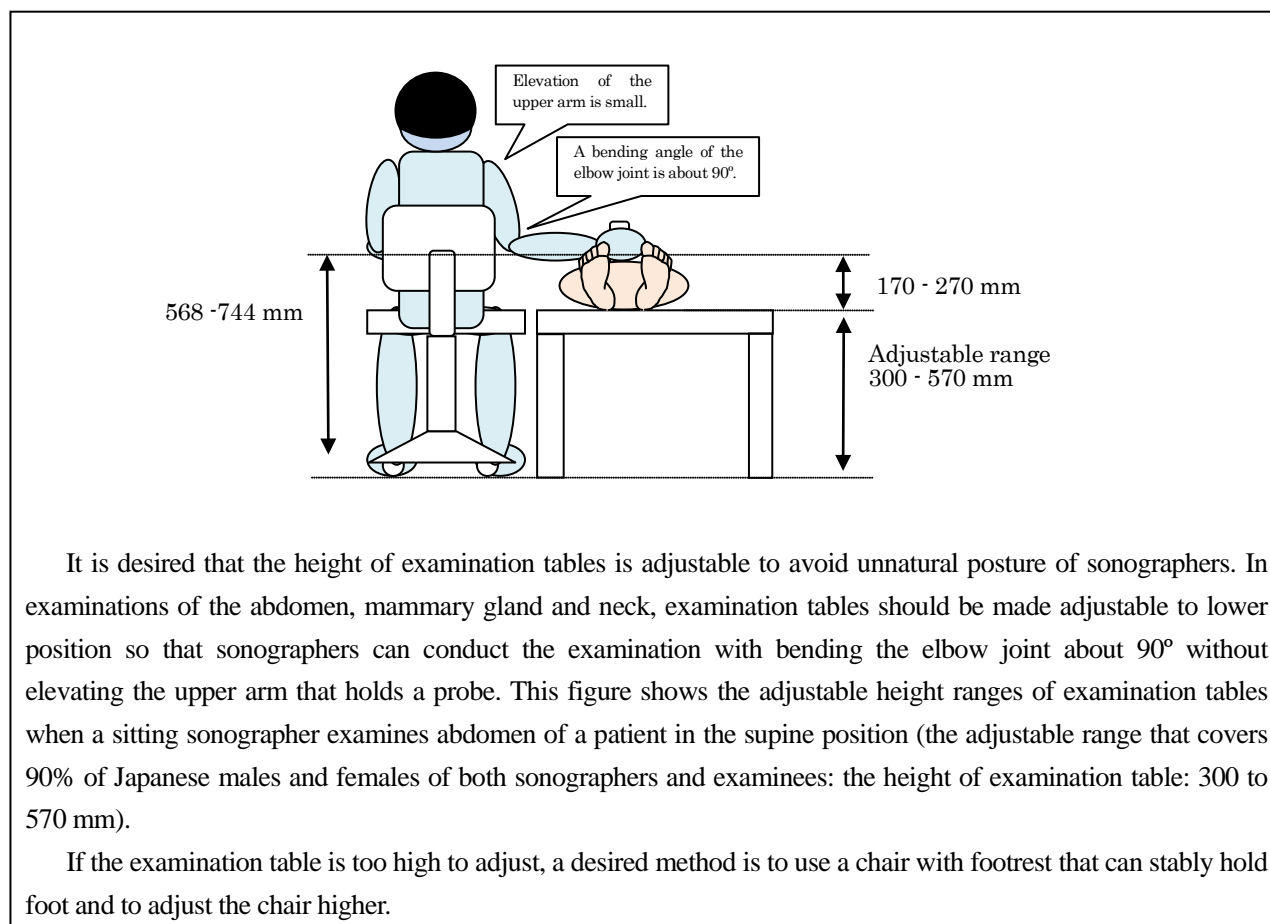
It is strongly recommended for managers of facilities conducting ultrasonography to implement the following countermeasures to prevent injuries of sonographers:

1. Development of ultrasonograph and equipment, and environment of examination room for easy examination operation

- (1) Examination rooms that have enough dimensions allowing appropriate adjustment of the layout
- (2) Lighting of examination rooms that can reduce eye-strain

It is desirable that to adjust the illumination of the examination room by the dimming control system for each examination room

- (3) Comfortable air conditioning and ventilation of examination rooms
- (4) Ultrasonic diagnostic equipment given ergonomic consideration
- (5) Height-adjustable examination tables
- (6) Height-adjustable chairs with a footrest available when foot does not touch on the floor



It is desired that the height of examination tables is adjustable to avoid unnatural posture of sonographers. In examinations of the abdomen, mammary gland and neck, examination tables should be made adjustable to lower position so that sonographers can conduct the examination with bending the elbow joint about 90° without elevating the upper arm that holds a probe. This figure shows the adjustable height ranges of examination tables when a sitting sonographer examines abdomen of a patient in the supine position (the adjustable range that covers 90% of Japanese males and females of both sonographers and examinees: the height of examination table: 300 to 570 mm).

If the examination table is too high to adjust, a desired method is to use a chair with footrest that can stably hold foot and to adjust the chair higher.

2. Information for sonographers about risks of musculoskeletal disorders, and implementation of prevention education

- (1) Disseminate risks of musculoskeletal disorders and countermeasures to people concerned.
- (2) Because concentration of particular posture becomes a risk of musculoskeletal disorders, it is desired that sonographers who work such examination environment learn a variety of examination methods. Here, a variety of

examination methods includes examinations of various regions and different examination techniques for the same region.

(3) It is necessary to disseminate about risks of musculoskeletal disorders in tasks other than ultrasonography, such as transfer of patients, and about methods that are safe for both examinees and sonographers.

(4) Training and education for skills to implement high quality examination efficiently in a short time is also effective for prevention of musculoskeletal disorders.

3. Development of management system for working hours of a day and working rotation

Prolonged or many times of implementation of highly straining examination is critical risk of musculoskeletal disorders. It is necessary to improve continuous time on task of examination and the number of examination of a day based on following two points:

Management of continuous time on task

It is necessary to avoid examination task that continues one hour and longer, and to manage so that 10 - 15 minutes break or tasks without holding a probe and a steady gaze of a display can be inserted between one-hour operations at a maximum. Risk of injury reduces more-when tasks without using ultrasonic diagnostic equipment, such as data input using a computer, are inserted every single examination rather than when examination is continuously implemented.

Management of working hours of a day

It is necessary to avoid working for too long hours in one day. Setting of the upper limits of hours and the number of examination can be considered as below on the presumption that continuous time on task is appropriate.

Because it is considered that ultrasonography has high risk due to the working posture, the upper limit of net total working hours of a day is 6.4 hours when operation is interrupted every one hour for 15 minutes and working hours of a day is 8 hours. The upper limit of the number of examinations differs according to duration of examinations. For example, the number of examinations is 12 - 25 cases a day, if one examination takes for 15 - 30 minutes.

4. Implementation of preventive countermeasures against musculoskeletal disorders related to tasks other than ultrasonography

It is necessary to pay attention to tasks other than ultrasonography. Transfer of examinees between a stretcher and an examination table and between a wheelchair and an examination table is a high-risk task. Therefore, it should be managed so that such tasks are avoided as far as possible. Transfer of examinees, who cannot stand up independently, alone should be avoided. Sonographers can implement a transfer only after they had received the training of the right transferring method and under the mentorship of healthcare staff who learned the right way. Use of appropriate equipment to reduce risks involved with transfer (such as a lift, a sliding seat, etc.) is desired.

It is effective to implement ergonomic improvement as much as possible for tasks other than ultrasonography, such as computer entry tasks as well.

5. Development of a system to get a grasp of the status of injury occurrence, and appropriate response

It is necessary to develop a system that can get a grasp of the status of injury of sonographers in the facility and can provide appropriate response to prevent musculoskeletal disorders as well as to prevent exacerbation of the injuries of sonographers who have injuries.

(1) The occurrence status of musculoskeletal disorders needs to be understood. To that end, it is necessary to provide opportunities to report and consult about musculoskeletal disorders.

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- (2) It is necessary to reinforce preventive measures indicated above when musculoskeletal disorders are occurred.
- (3) It is necessary to lighten the workloads of the persons who have musculoskeletal disorders and who report symptoms.
- (4) It is necessary to make an arrangement to allow to receive required treatment and to take a leave of absence required.

Recommendations for ultrasonic diagnostic equipment manufacturers and technology developers

In design development of ultrasonograph, design should be done by assuming what kind of layout and methods sonographers use to conduct tasks in actual examination room environment to avoid working posture has risks of musculoskeletal disorders. At that time, the size and the adjustment range of the equipment parts should fit to people within the range of at least 5 to 95 percentile based on statistical data of various body sizes of users.

1. Main unit of ultrasonograph

It is required that movement of the main unit of diagnostic equipment and locking procedure are easy and less straining. It is desired to change to smaller and lighter equipment suited to the layout of the facility.

- (1) It is required that the equipment can be easily moved all alone by attaching casters and handles to the main unit to adjust the position of the main unit frequently depending on the area to be examined and the body type of patients.
- (2) The width and depth of the main unit should be designed compactly so that the position of devices and the angle with respect to the examination table are adjustable even in a space of a small examination room.
- (3) A space to place the knee and legs under the operation panel is needed to form a natural working posture.
- (4) Holders of a probe and ultrasound gel, which are frequently used during examination, should be placed in a position that does not interfere with examination, are in the working area, and can be easily reached without changing the posture for examination.

2. Operation panel

Ideal position of operation panel is the position that allows operating the panel with bending the elbow into about 90 degrees without elevating sonographer's arm (called "elbow height rule").

- (1) The thickness of operation panel needs to be thin to ensure a space to put feet.
- (2) Design an operation panel and display independently so that the position of the both operation panel and display is independently adjustable to different positions.
- (3) Design operating units on an operation panel so that operating units would be within a range that sonographers could reach it easily when they are taking a posture to operate a probe.
- (4) Design operation panels so that the panel is adjustable to the height that allows operating the panel in a posture with bending the elbow into about 90 degrees without elevating sonographer's arm (elbow height rule). Also, the adjustable range of the height should cover a range that deals with the possibility of standing position and crouching position in addition to sitting position.
- (5) Operation panels should be designed so that the end of the panel can be moved to the end of the examination table by adjusting the position of the panel to right or left or by adjusting the position of the main unit.
- (6) An operation panel should be designed so that the panel can be pulled nearer to a distance of the length of sonographer's forearm (a position that allows operating the panel in a posture with bending the elbow into 90 degrees without elevating sonographer's arm).
- (7) Adjustment of operation panel position should be easy and quick.
- (8) The forearm or wrist needs to be supported in the front of the operation panels.
- (9) Standardization of the manner of operation among different devices is desired.
- (10) Give consideration to the position of operation interfaces other than operation panel, such as a touch panel.
- (11) Design the operation panels so that visual indications including lamps are adaptable to a bright room.

(12) Elimination of limitation in the left arm posture during frequently conducted operation by employing a remote control (near the left hand, or on a probe) or voice-recognition technology is desired.

3. Display

Displays that are adjustable image quality as well as position, height, and angle in a wide range are desired.

- (1) Expansion of use of the most recent display equipment such as liquid crystal displays that are thin and lightweight and easy to adjust its position, also reduce glares is desired instead of CRT. Displays that have adequate resolution and high-speed performance, and that brightness and contrast are adequately adjustable are desired.
- (2) Because it is desired to lighten the room 300 lux and brighter in view of load to eyes, it may be recommended to use displays that images are clearly viewable even in a bright room of 300 lux or brighter.
- (3) Displays should be height adjustable so that working posture becomes appropriate.
- (4) When it is envisioned to use in the upright position, make displays height adjustable in corresponding to the position.
- (5) Displays that are adjustable to lower position in corresponding to a crouching posture for examination of lower extremities are also desired.
- (6) The right and left position and angle of displays should be adjustable to minimize rotation of the neck to watch the display.
- (7) Make a distance between a display and sonographer's eyes adjustable at a distance that a visual angle becomes 30° to 45°, or further.
- (8) Make adjustment of the position, height, and angle of displays easier and quicker in one hand with remaining in a working posture.
- (9) Give consideration to visibility of images and textual information indicated on display with software to avoid workloads on sonographers in possible various display positions.

4. Measures for probes and cables

Cables of probes should be designed so that the cables can be placed without interrupting the operation and without touching examinees. Changeover to cordless devices is desired in the future.

- (1) Thickness and shapes of grip of probes should be selectable appropriate to the size of user's hand and working methods.
- (2) Development research on grips appropriate to various working methods is desired.
- (3) Lighten probes.
- (4) Soften and lighten cables.
- (5) Improve distribution of cables to avoid disturbing examination.
- (6) Improve mating and de-mating of connectors easier.
- (7) Introduction of cordless probes is desired.

5. Development and expansion of use of auxiliary machineries

1) Improvement of examining tables

Development and expansion of use of special examining tables to optimize working posture during ultrasonography is the most important tasks for decrease of workload and prevention of musculoskeletal disorders in sonographers.

- (1) Make examining tables height adjustable.
- (2) Development and expansion of use of examining tables that can reduce twist of the back during cardiac examination that is conducted with sitting on the table is desired. Make tables adjustable to suitable height to sit on it.
- (3) Development of examining tables for examination of lower extremities is desired.

- (4) Development of examining tables that can adjust the angle of patients is desired.
- (5) Development of examining tables that can easily adjust the vertical position of examining tables is desired.
- (6) Expansion of use of Gatch bed-type examining tables is desired.
- (7) Development of a rail etc. of examining tables to prevent patients from downfall without disturbing examination is desired.
- (8) If safety of patients can be secured, examining tables that are smaller in width enable sonographers to come closer to the area to be examined.
- (9) It is desirable that the length of examining tables has extra space that allows adjusting the position of patients to up and down.
- (10) Development of examining tables that can adjust the right and left angle of the patients is desired to make operation at distant abdominal region (the left side) easier.

2) Improvement of chairs and a sitting posture

- (1) Development and expansion of use of chairs equipped with footrest to put feet stably on a suitable position suited to the situations that sonographer's chair is need to be positioned higher is desired.
- (2) Expansion of use of chairs that can easily move with casters and can be easily locked is desired.
- (3) Development of chairs that are improved so that a sonographer can come closer to the examining table for cardiac examination is desired.
- (4) Development and improvement of equipment is desired to avoid a crouching posture that is taken during examination of lower extremities.

3) Armrests

- (1) Development of armrests to support the arm that can hold a probe during examination of the abdomen, mammary gland, lower extremities, and neck is desirable.
- (2) An armrest designed for sonography attached to a chair may be effective as measures to reduce load to the arm of the probe side.

4) Partial automatization of examination

To support sonographers engaging in examination involved with great workload, it is promising to promote development of methods for certain available examinations to secure a probe using instrument without holding the probe with a hand, and technologies to automate examination to reduce workload.

6. Expectation for development of new design ultrasonograph that has low workload on sonographers

Workload of sonographers due to their posture may become smaller to some extent by enabling the position of display and operation panel of equipment flexibly adjustable in a wide range, and by enabling the height of examination tables adjustable. However, these adjustments do not lead to a fundamental solution of unnatural working posture. Development of auxiliary equipment that enables to adjust examination region of patients to a suitable position with remaining the sonographer in natural posture, and diagnostic devices that allow flexible adjustment of the position of displays and operation panels is desired.

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