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BIOMECHANICAL STRUCTURING FOR FIGURE SKATERS

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PRELIMINARY PILOT STUDY REPORT
presented to the USFSA Research Committee
in proposal for investigating the effects of
Biomechanical Structuring
on Junior Elite Figure Skaters

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BIOMECHANICAL STRUCTURING FOR FIGURE SKATERS

Introduction

Biomechanical structuring for figure skaters (BSFS) is a technique for mobilizing and balancing the connective tissue of the body. It involves the use of skills taught in physical therapy schools for many years, including massage, therapeutic exercise, endurance training and flexibility. In addition, appropriate techniques from proprloceplive neuromuscular facilitation, [1] trigger point therapy, [2] myofascial release, [3] craniosacral therapy, [4] muscle energy, [5] strain and counterstrain, [6] and manual therapy with deep tissue work will supplement the techniques.

Another portion of hands on work will be based on the principles of structural Integration (Rolfing) developed by Ida P. Rolf, Ph.D. whose degree was earned in biochemistry. She related the stresses expressed in the human body structure to the force of gravity and then developed a process to reverse these stresses through application of gentle, directed, and sustained pressure. Her goal was to give the body more freedom of motion, increased balance, and greater flexibility in the gravity field. This process also allows the individual to become more aware of body movements in space. "The goal of structural integration is a more resilient, higher-energy system."[7]

To date little research has been done to document the changes possible through these techniques. However, lack of documentation should not invalidate their results. The changes affect the entire body and many of the organs simultaneously, complicating a desired simple research hypothesis. Changes experienced through the use of these new release techniques often are not achieved with conventional therapies. For example, John Cottingham, M.S. reports that one movement In structural integration affects the total autonomic nervous system.[8] Currently all of these new clinical techniques are being taught in schools of physical therapy and in approved continuing education programs for physical therapists, nurses, osteopaths, chiropractors, and medical doctors.

DISCUSSION

Analysis of the picture series taken at the Olympic Training Center Camp has shown that many of the skaters could be helped by the techniques of biomechanical structuring. The techniques which will be utilized in this study have been and are now being used by a number of world class figure skaters including Brian Orser, The Protopopovs, Isabelle Brasseur, Karyn Garossino, and Tracy Wilson.

Brian Orser said, "When you are Rolfed you feel a sense of confidence..it virtually puts you back in place. You're in line with gravity and you feel lighter" [9, 10] He also credits Rolfing with helping him with his compulsory figures. He said, "It all makes sense. Figures are all about balance and gravity.' [11]

Physical Therapy, including the newer techniques of manual therapy and soft tissue release are being used everywhere across the country with Olympic class athletes. Several USA synchronized swim team girls who won the Gold In Japan 1976, were Rolfed so team members would have balanced flexibility and greater range of motion. Some of the members of the present USA Olympic trial swimming team as well as members of the rhythmic gymnastic team have had structural Integration (Rolfing). At the 1980 Olympics, Rolf practitioners worked with a few of the runners In order to decrease the amount of rotation in their legs. All who participated improved their times. At the 1984 Olympics in Los Angeles, the Chinese team requested the services of Rolf practitioners for their team members because of the benefits they had seen from its application following two cultural exchange visits by members from the Rolf Institute.

In addition, members of this research team have Rolfed highly ranked national tennis players, major league baseball players, world class biathletes and professional ballerinas. All these athletes have reported experiences similar to Brian Orser In that they have gained an understanding of their own bodies and have Improved their own performances.

RESEARCH DESIGN AND PROCEDURES

Hypothesis

The hypothesis of this study is that biomechanical structuring will give the skaters in the Junior Eliie class an advantage In the performance of their skills over those who have not had this experience. The dual goals of this study are, 1) to document changes in figure skaters over time in relation to posture, flexibility, mobility, height, weight, vital capacity, soft tissue problems, and skating ability; and 2) document the changes occurring following biomechanical structuring of figure skaters (BSFS) to determine the differences between this group and those who have not experienced this process.

Population

Eighteen subjects (eight females and ten males) participated in this pilot study. Their ages ranged from thirteen to twenty years. The average age was sixteen years, two months. All were junior elite skaters and members of the United States Figure Skating Association. 'At this time in the study, this group may all serve as the experimental (treatment) group, if they elect to experience BSFS. Controls will be those skaters who do not experience BSFS.

Instruments

Each subject was requested to fill out a questionnaire (Appendix B). The questionnaire asked the skaters to determine how they felt about their bodies, and to assess where they had strengths and weaknesses or injuries and pain that would influence their skating.

A series of twenty photographs was taken of each skater in minimal attire standing barefoot to clearly depict posture and body alignment. A square two feet by two feet was outlined on the floor In which the subjed stood. The center of this square was used as the focal point for the cameras. Two matched cameras were placed at right angles to this point and at a distance of ten feet one Inch to the front of the camera lens and at a height of thirty three inches above the floor. (Figure 1)

A third camera was mounted directly above the center point of the square at a distance of about three feet over the subject's head. Plumb bobs were hung at the midpoint of the square outline between the floor cameras and the subject. Three 3200 K flood lights on adjustable stands were placed to light the subjects appropriately.

An eight Inch high box was used for the subject to stand on for one picture. For one other picture a padded table top was used for the prone (backs of legs and feet) and for three pictures supine (hip flexion, right and left, and trunk stability.)

Uniform directions were read to the subjeds before each picture was taken. A plumb line was hung and aligned at the front of the body to be as close as possible to the body mass center in the front and back views and to be at the anterior edge of the lateral malleolus for the side views.

The pictures taken were as follows:

Relaxed standing: front, tight side, left side, back view, overhead
Turning head: right side, left side, overhead
Turning head and trunk: front, right, left, overhead
Bending backward: side view
Bending forward using box to stand on to allow for full **flexion:** side view
Bending trunk to side: front, right, left
Psoas hip test: Supine on table, side'view, **right** leg, left leg (Figure 2)
Trunk stability: left side view (Figure 2)
Foot ankle alignment: Overhead of ankles and feet.

In those skaters who choose to participate In b&mechanical structuring, the pictures will be used as a guide in developing an Individualized program for each skater, and to show changes as they proceed through the biomechanical structuring process. The experimental group (subjects who experience BSFS) will also have completed the following at the conclusion of the full research study.

Posture

Posture will be evaluated using photographs. They permit **study of** the changes of the skaters' postures with maturation, show symmetry and balance In stance and allow the Investigators to study deviations from "**normal** posture.'

Flexibility

Flexibility will also be documented with photographs. These will include **psoas—** quadriceps length **12,** head rotation, trunk rotation, trunk **flexion,** trunk extension, trunk lateral bend, standing arms overhead, spinal mobility, trunk leg interaction (supine), leg foot position (prone). These pictures will show the skaters ability to vary their posture from their normal standing position, and to recognize where they are prone to injury because they are inflexible. Photographs will also be used to determine how flexibility **affects performance over time,** and how this **aff** eds skating. In addition, **it** will show changes In those skaters who have experienced biomechanical structuring for figure skaters (BSFS) over time.

Mobility

A video camera will be used to study several aspects of the skater's posture as well as their postural stance and walking. These will be followed by standing in place on blades and skating in free glide. Some video footage will also be analyzed during free skating to Include foot work, a compulsory figure, a spin, and a jump. These studies are necessary to determine optimal ankle-trunk positioning for each skater, to develop Indiildual programs for them and to show how skaters in the biomechanical structuring for figure skaters process change over time. These videotapes will show how the process Influences the functional use of the body and the artistic presentation of the skater.

Individual Problems and Injuries

A questionnaire will be used to determine how skaters feel about their bodies and whether or not they feel they need help with soft tissue problems. It will also give a record of Injuries sustained during the course of the study. Answers will be provided in writing and by a body figure marked with a grid. This is necessary to determine what kind of injury or problem skaters sustain from Incidences on and off the ice, to determine the skaters attitude toward these problems, and how they assess their performance. It will also give skaters a vehicle to report whether or not they feel blomechanlcal structuring for figure skaters (BSFS) alters their performance.

MEASUREMENTS

All pictures were developed as 35 mm color slides. Selected pictures were then reproduced as 4x6 prints for measurement data. ‘Measurements were taken using selected drafting tools Including a parallel glider, protractor and calipers. Outlines of the body shapes were also drawn In order to depersonalize the subjects (Appendix A.) Validation of measurements was achieved by three outside Independent raters. Inter-rater agreement was attained at 95 per cent accuracy indicating sound Internal reliability for the data. The outlines and photographs will serve as reporting tools of base line and post treatment data to the figure skaters, coaches, and other researchers.

Photograph Outlines

Pelvic angle measurements were ascertained from precise procedures. Selected 4x6 color photographs were developed from the original 35 mm slide negatives of static posture views of the subjects showing pelvic angle, scapula and head rotations. These events were selected because they most specifically corresponded to the needs and desires of the respondents based on the sports medicine questionnaire. Outline tracings were made of the subjects’ photographs using an x-ray view box. Drafting instruments facilitated precise measurements of degree angle by careful scrutiny through lighted magnification lens.

Lumbar Pelvic Angle Procedure

Tracings of the side view of the lumbosacral "S" shaped curvature were performed on each subject's photograph. The shape of these curves varied in length and arc form. As the curve form reverses itself, the central portion of this line Is relatively straight. Points were set at each end of this section and were connected with a line. This line was extended to meet the plumb line which served as a constant reference on the photograph and an angular degree measurement was taken. The height of the cameras lens from the floor at thirty three inches corresponds closely to the region of the subject's pelvic angle to minimize parallax effect. (Appendix A)

Head Rotation Measurement .

Camera views from overhead showed the top of the shoulders and head. A straight edge was placed across the photograph outline shoulders joining the acromion processes just posterior to the acromioclavtcular joint. The center of the head was located and center point of the straight edge of a compass was placed on this point and parallel to the shoulder line. A line of surgical silk secured to the compass center point passed from the center of the head to the nose tip, to measure the number of degrees for range of motion. (Appendix A)

Scapular-Trunk Relationship

Back views of photographs were observed for scapular asymmetry 1) relative superior—inferior comparison of both scapulae, 2) winging of scapula from wall of the thorax, and 3) medial-lateral rotation of Inferior angle of the scapulae. These photographs were ranked according to the amount of aberration by simple observation by the raters.

ANALYSIS OF DATA

Ouestionnaire

The questionnaire (Appendix B) was composed of eight open response questions. Each of the eighteen respondents were tallied for every question **item.** Figures **3, 4,** and 5 display the . raw data tabulations.

Question item 1 asked "How do you feel about your body and how you use **it** in skating?" Fourteen of the subjects listed positive responses and four fisted some negative aspect.

In response to question 2, Where do you feel the strongest?" fourteen subjects listed legs, **six** trunk, and one said upper body.

Question 3 asked skaters, 'Where do you feel you are weak?' Ten skaters indicated their arms were weak, three listed ankles, one mentioned knees, and two listed stomach with two giving no responses.

Question **item** 4, "Where do you feel tightness?" yielded multiple responses. Eight listed hips, seven, legs: **five,** back; two each for neck, shoulders, **arms,** knees, stomach, calves: three **listed** no tightness.

Item 5, Where do you feel you have **excessive** looseness? **yielded** ten responses with none, and eight subjects listed yes: knees, neck shoulders, stomach, hips, **ribs** sides torso, arms, gluts hips thighs, stomach back.

Question **item** 6, "Do you feel both sides of your body have equal flexibility?' Twelve subjects Indicated they were balanced and six said no, they were not equal.

Question **item** 7, What would you **like to** change about your body **if** you could?' Five subjects desired stronger shoulders and chest, five, smaller buttocks and thighs, four, greater flexibility, three Increased strength, one, no bunions, and one, taller.

Question **item** 8, "Do you have pain or **loss** of motion In any areas of your body?' Eight subjects reported pain or **loss** of motion. **Five** said back pain, three hip pain, two knee pain, one each listed groin, hamstring, leg, thumb pain.

Ouestionnaire and Photographs

The responses of the skaters to the sports medicine questionnaire were tabulated, summarized and related to the picture series. Three **particular** aspects were selected from the large data pool collected for this preliminary study report. Upon examination and **comparison** of the photographs and questionnaire responses, the three areas chosen for analysis were **Lumbar-**Pelvic Angle, Neck Rotation, and the Scapular-Trunk Relationship. Tables I-3 display data summary.

TABLES

Data Summary of Selected Measurements determined by the Responses
from the Questionnaire
Data taken from Tracings and Original Photographs

Subject Number	1 Lumbar Pelvic Angle Normal Range Variable		2 Head Rotation Full Flange = 90'		3 Scapulae Trunk Relationships Normal-Symmetrically held against Thoracic Wall
	Right	Left	Right	Left	
2			66.5"	59°	--
3	24.5"	23°	53"	53°	N
4					N
5	42"	42.5"			-
6					
7	32°	33.5.			--
8	44°	44.5°			++
9			48°	46°	
10			47"	43"	+++
11			82°	62°	++
12			70°	65°	+
13			41°	34°	+
14			53°	47°	
15			64°	54°	+++
16	30.5"	36"	51.5°	51°	+++
17	30°	34°	60°	66°	++
18			72°	63°	++
19			49°	65"	++

1. Lumbar pelvic angle side view angle formed by a line lying parallel to the slope of the sacrum with the vertical plum line.

2. Head Rotation overhead view angles showing range of motion of the head turning to right and left.

3. Visual ranking of the photographs from positions of holding (bracing) -- to normal (N) evidence of weakness (+ to +++).

1. Lumbar-Pelvic Angle was selected due to tightness of hips as the most common complaint of the skaters. Increased angulation hinders full extension on jumps, increases the possibility of injury on impact of landings, and detracts from the artistic presentation of skaters. (Appendix A)

2. Head Rotation was chosen due to lack of full neck rotation as seen In the photographs. A lack of 1/3 to 1/2 of normal range of motion by over half of the subjeds or an uneven lack (greater than 5°) by some subjects when comparing rotation to the left and right was computed. Lack of neck range requires more shoulder and truck rotation In executing figures which can easily affect the ice skater's blade position on the Ice.' (Appendix A)

3. Scapular Trunk Relationship was selected since ten of the eighteen skaters considered the shoulders and arms to be the weakest areas of their bodies. Without strong axial musculature, jumps and spins are more difficult. Analysis of the photographs suggest this weakness to be most common.

Skater Benefits Summary

Each skater and coach will be given a summary Including a discussion of particular benefits gained through a program of blomechanical structuring, along with the report to be presented at the Olympic Training Camp in September, 1988. Skaters may expect to Improve posture, strength, and flexibility as well as attain more freedom of motion and body balance.

Correlation of Data with other Studies Ongoing at the Olympic Training Camp

Investigators may appreciate sharing of data with other researchers working with the skaters at the training camp. Data including height, weight, vital capacity, treadmill maximal endurance values, body mass centers, standing and jump height before and after four minute skate, and similar data would be of interest. Strength and range of motion status would also be complimentary. This data would be used to compare skaters who have experienced biimechanical structuring for figure skaters (BSFS) with those who have not done so in order to evaluate whether this process Influences the qualiiy of their skating.

CONCLUSION

It has been proposed that **evaluation** of posture, flexibility, and mobilii of figure skaters would be of assistance to Junior Elite skaters as they develop their skating, and also assist in injury prevention. Skaters who decide to experience the process of b&mechanical **structuring** for' figure skaters (BSFS) should experience more upright posture, increase freedom of motion, and greater awareness of their bodies In the gravitational field. These changes will influence their performance to greater precision in execution, better balance, and more **efficient** muscle use. In addition, they may have greater endurance and a more artistically pleasing program.

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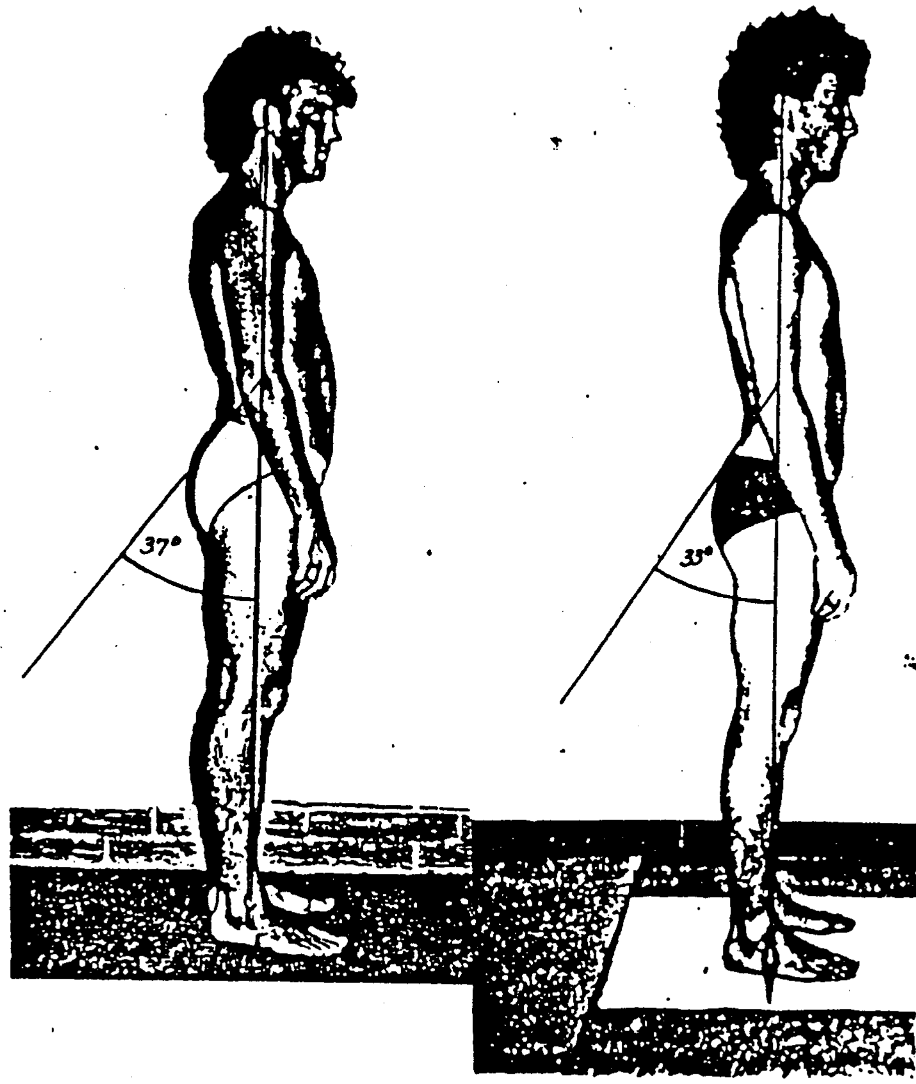
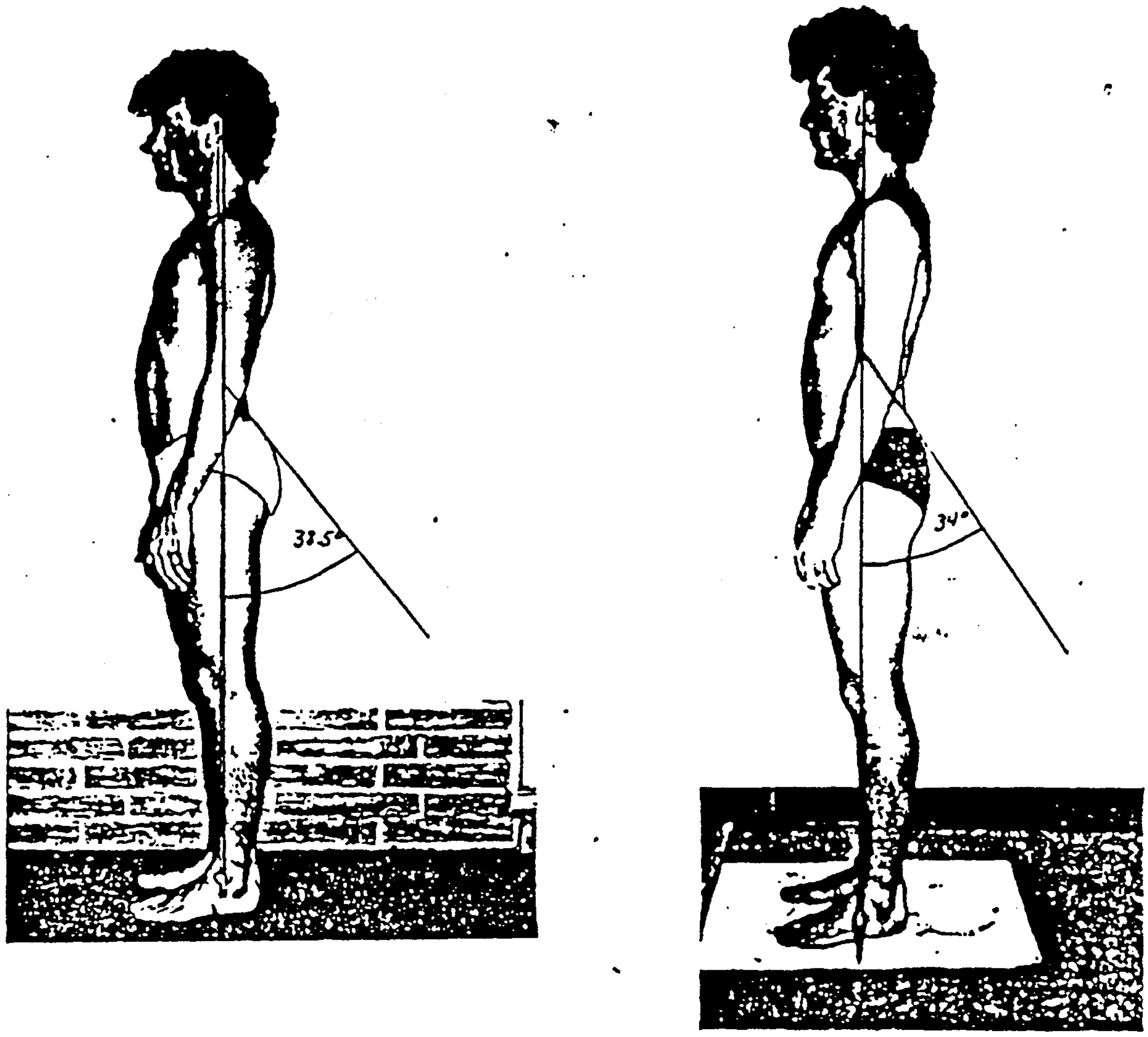
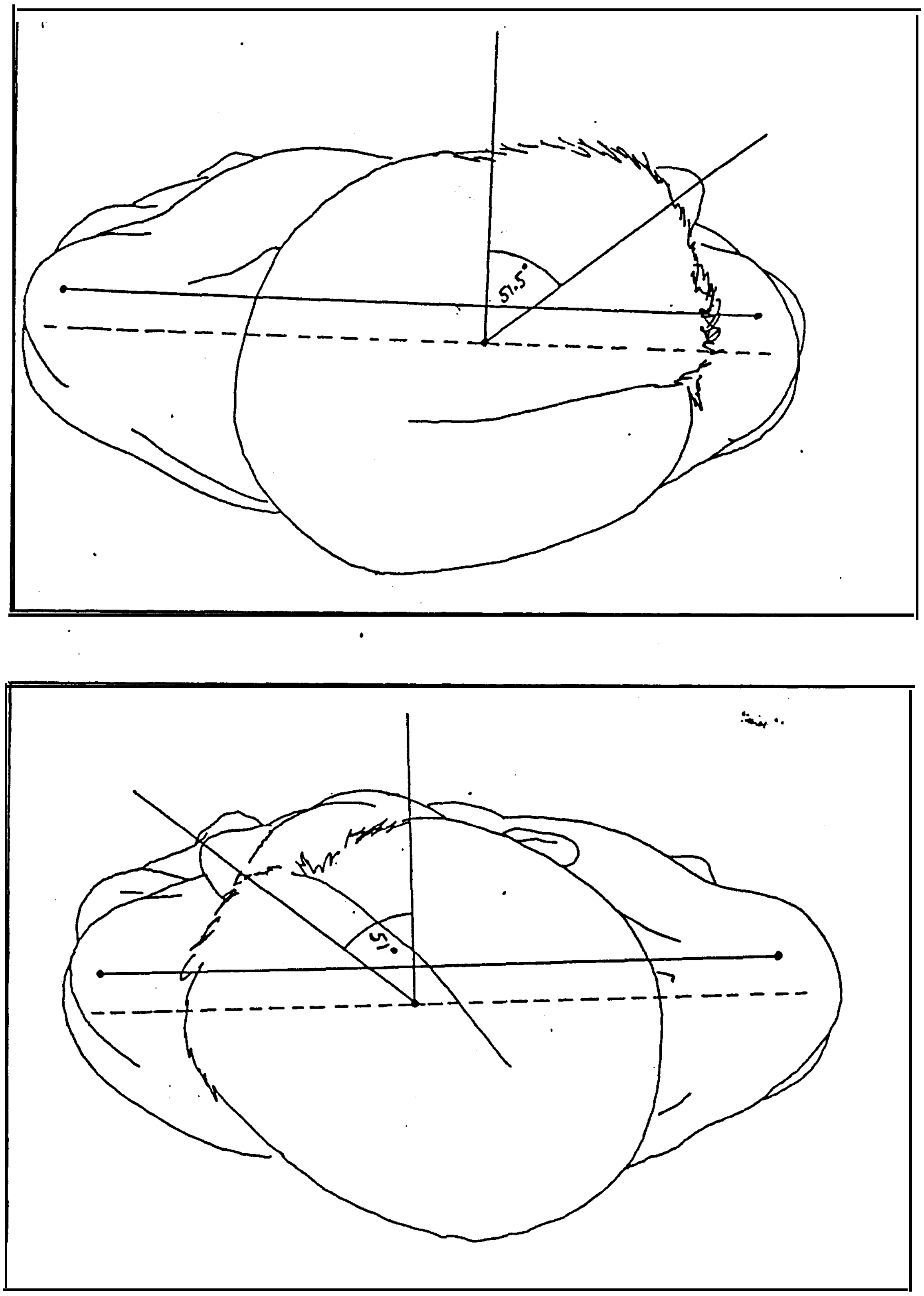
APPENDIX A



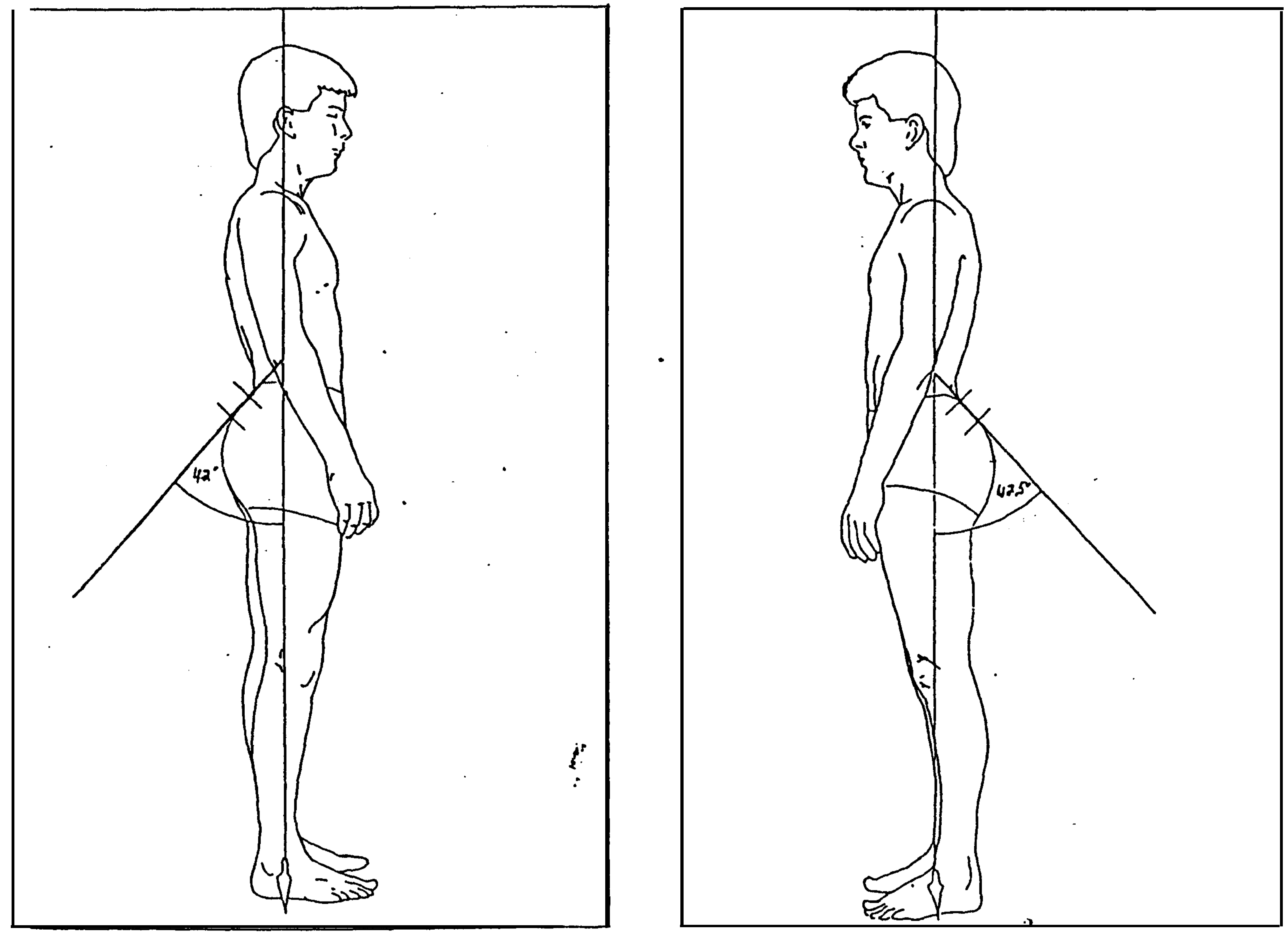
BRIAN ORSER
Showing view from right side Lumbar Pelvic
Angle before and after Biomechanical **Structuring**
(Permission Granted)



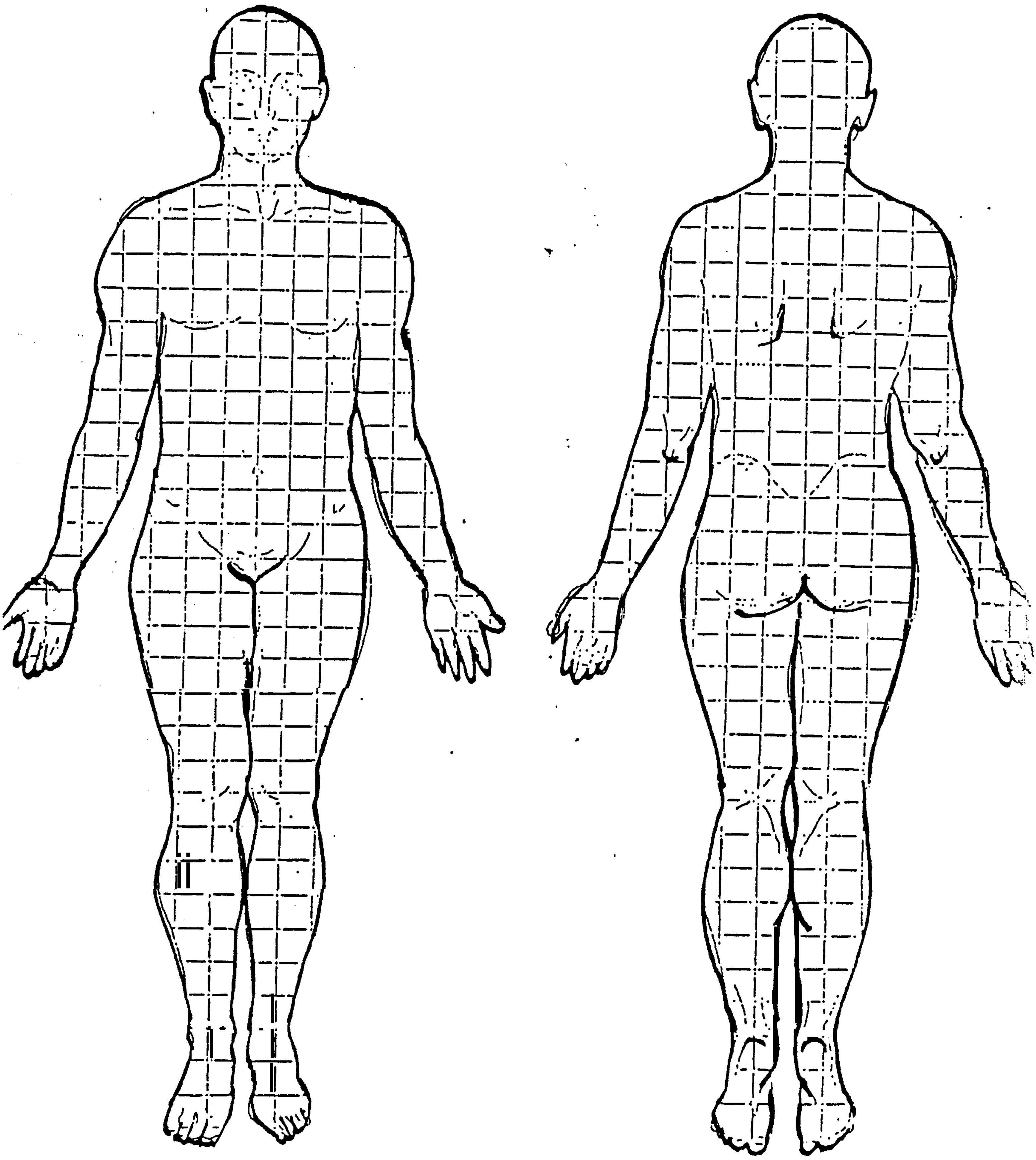
BRIAN ORSER
Showing view from **left** side Lumbar Pelvic
Angle before and after Bbmechanical **Structuring**
(Permission Granted)



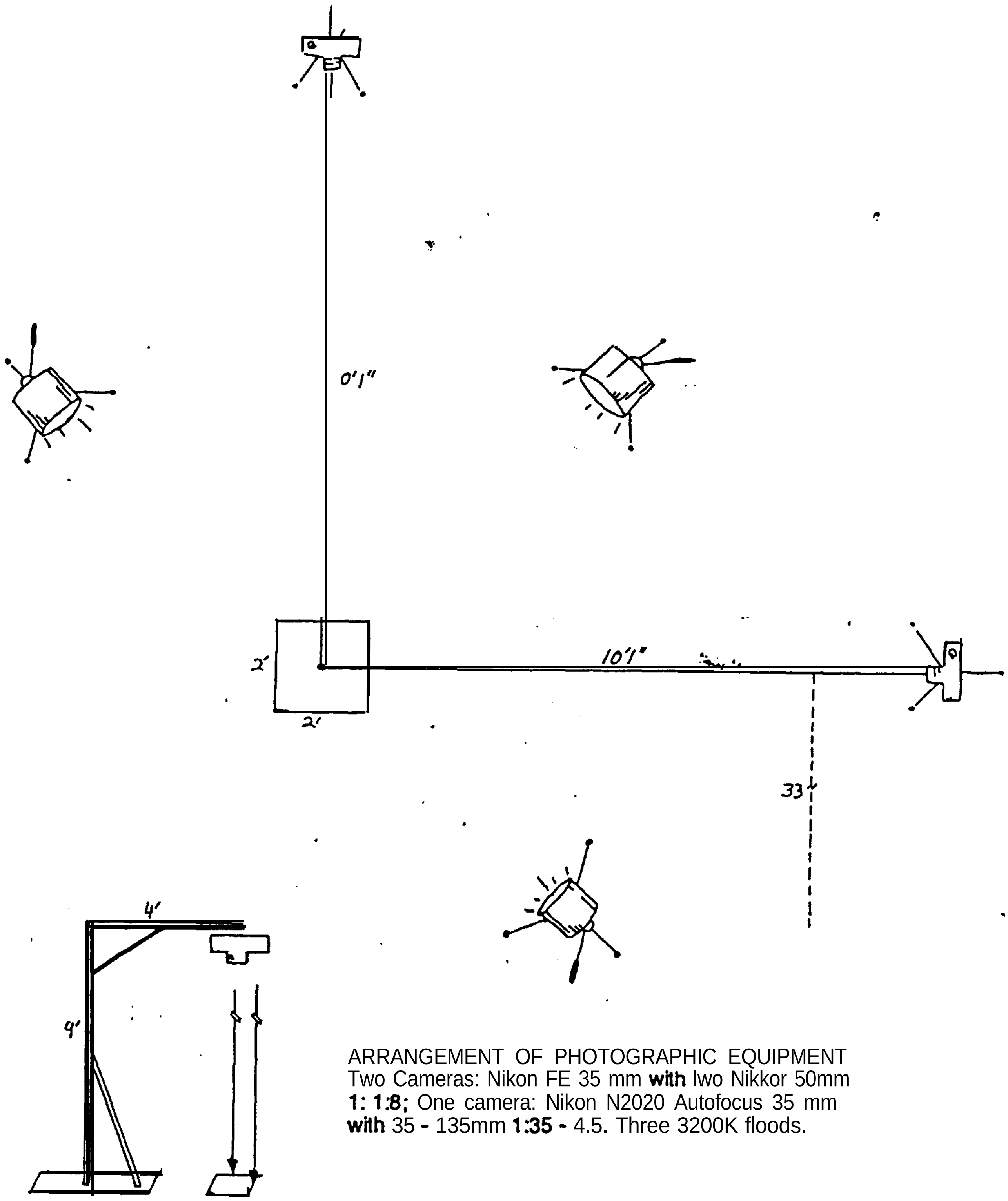
OUTLINE TRACING FROM PHOTOGRAPHS
Overhead view of Head Rotation to Right and Left



OUTLINE TRACING FROM PHOTOGRAPHS
Subject views from Right and Left Sides Lumbar Pelvic Angles

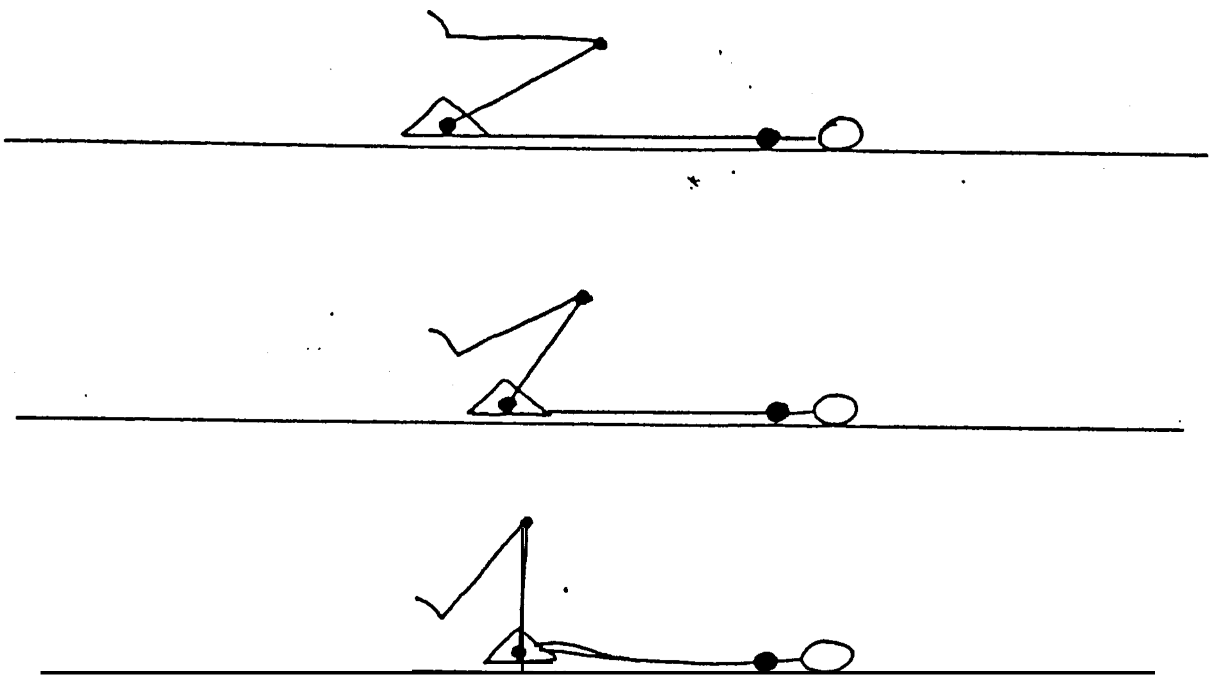


BODY CHART

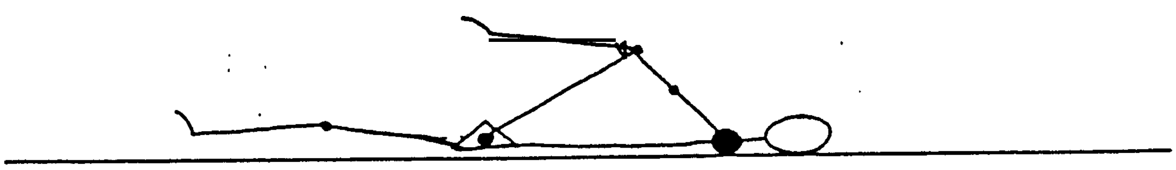


ARRANGEMENT OF PHOTOGRAPHIC EQUIPMENT
Two Cameras: Nikon FE 35 mm **with** lwo Nikkor 50mm **1: 1:8;** One camera: Nikon N2020 Autofocus 35 mm **with** 35 **-** 135mm **1:35 -** 4.5. Three 3200K floods.

F I G U R E **1**

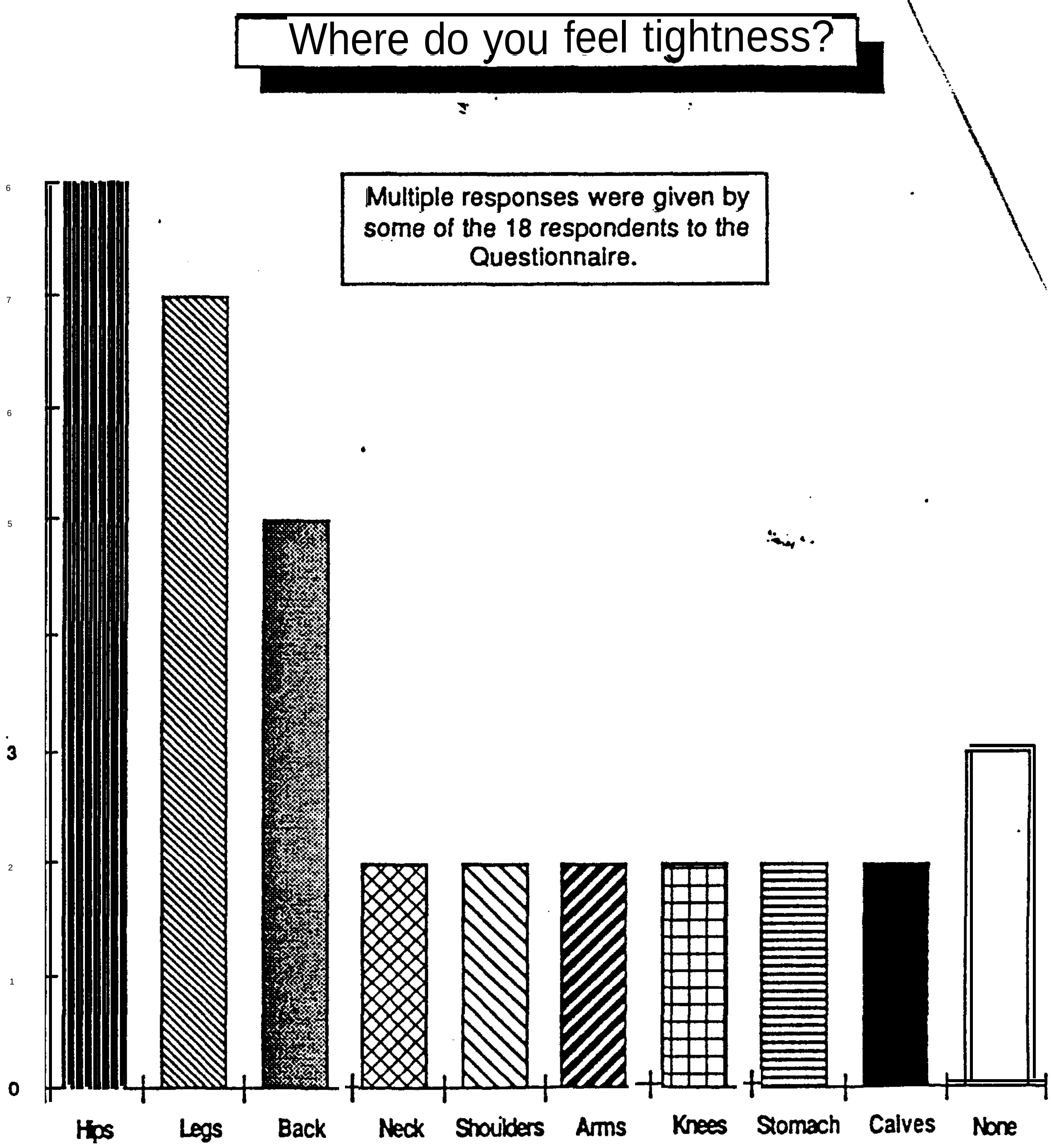


TRUNK STABILITY



PSOAS HIP TEST [12]

FIGURE 2



Where do you feel tightness?
Multiple responses were given by some of the 18 respondents to the Questionnaire.
6
7
6
5
3
2
1
0
Hips
Legs
Back
Neck
Shoulders
Arms
Knees
Stomach
Calves
None

FIGURE 4

RAW DATA DISTRIBUTION and ITEM ANALYSIS
Taken from Questionnaire

Multiple Responses were Given by some of the 18 Respondents lo the Questionnaire

Subject	Loose	Flex.	Use
	ITEM # 5	ITEM # 6	ITEM # 1
2	no	yes	fine
3	no	no	fine
4	knees	l > r +no	fine
5	no	yes	happy
6	no	yes	strong
7	neck,shoulders	no	light, energetic
8	no	yes	fine
9	stomach	yes	neg. legs
10	no	yes	pretty good
11	hips	l > r +no	neg. stronger
12	no	yes	neg. endurance
13	no	yes	good
14	ribs, sides, torso	yes	good
15	arms	no	neg.not optimum
16	gluts,hips,thighs	yes	stronger
17	no	no	
18	no	yes	fine
19	stomach,back	yes	satisfied

ITEM # 2 Strongest:

Legs	14
Trunk	6
Upper body	1

ITEM # 7 Changes desired:

Stronger shoulders and chest	5
Smaller buttocks and thighs	5
Greater flexibility	4
Increased strength	3
No bunions	1
Taller	1

ITEM # 8 Pain or loss of motion:

Back pain (Lumbar 3, Thoracic 1, Cervical 1)	5
Hip pain	3
Knee pain	2
Groin pain	1
Hamstring pain	1
Leg pain	1
Thumb pain	1

FIGURE 5