

1

2

3

: 40 가

: 26 36 68 38 42

31 (DEXA)

, ( 2 4 ) (con -

ceptional age)가 40 0 ,

3 ,

student t - test (Pearson's Correlation) ,

$p=0.05$  .

:  $0.137 \pm 0.018 \text{ g/cm}^2$  (0.061 - 0.202  $\text{g/cm}^2$ ),

$0.089 \pm 0.013 \text{ g/cm}^2$  (0.065 - 0.123  $\text{g/cm}^2$ ) ,

$0.214 \pm 0.030 \text{ g/cm}^2$  (0.160 - 0.296  $\text{g/cm}^2$ ),  $0.118 \pm 0.014 \text{ g/cm}^2$  (0.096 - 0.162  $\text{g/cm}^2$ )

$p<0.05$ ) (r=0.384,  $p<0.05$ ) (r=0.438,

(r=0.281,  $p<0.05$ ), 가 (r=0.223,  $p>0.05$ ).

: 0 .

3 가

(12),

80%가 (1 - 4). DEXA

, ,

가 .

, (photon absorptiometry),

(Quantitative CT, QCT),

(Quantitative US), 68 ( : =46:22) 31 ( : =13:18)

(Quantitative MR) (3 - 11). , 26 36 ,

(Dual Energy X - ray Absorptiometry, 38 42 . 1666

DEXA)  $\pm 402 \text{ g}$  (1035 - 2620  $\text{g}$ ) ,  $3476 \pm 521 \text{ g}$

(1, 2, 8, 11, 12). DEXA (2390 - 5000  $\text{g}$ ) . ,

for gestational age), (large for gestational age) (0.065 - 0.123 g/cm<sup>2</sup>) ,  
 0.214±0.030 g/cm<sup>2</sup> (0.160 - 0.296 g/cm<sup>2</sup>)  
 0.118±0.014 g/cm<sup>2</sup> (0.096 - 0.162 g/cm<sup>2</sup>)  
 (p < 0.05) (Table 1).  
 820 mg, 410 mg, D 740IU가 ,  
 가  
 가 40  
 (corrected age) 0  
 3  
 XR - 26 MARK II (NORLAND, Baarn, Netherlands)  
 2.7 cm  
 2 4  
 2.5 cm, 1 cm  
 30 2 30 , 1  
 (Fig. 1).  
 55  
 , , alkaline phosphatase  
 가  
 가  
 student t - test (correlation analy -  
 sis) , p=0.05  
 0.137 ± 0.018  
 g/cm<sup>2</sup> (0.061 - 0.202 g/cm<sup>2</sup>), 0.089 ± 0.013 g/cm<sup>2</sup>

(r=0.384, p < 0.05)  
 (r=0.438, p < 0.05) 가 가 가  
 (Fig. 2).  
 가 (r=0.281, p < 0.05),  
 가 (r=0.223, p > 0.05)  
 (Table 2, Fig. 3).

**Table 1.** Comparison of Bone Mineral Densities (BMD) Using Dual Energy X-ray Absorptiometry on Preterm and Full-term Infants

	preterm (n=68)	full-term (n=31)	p-value
BMD-spine (g/cm <sup>2</sup> )	0.137 ± 0.018	0.214 ± 0.030	p<0.05
BMD-wrist (g/cm <sup>2</sup> )	0.089 ± 0.013	0.118 ± 0.014	p<0.05

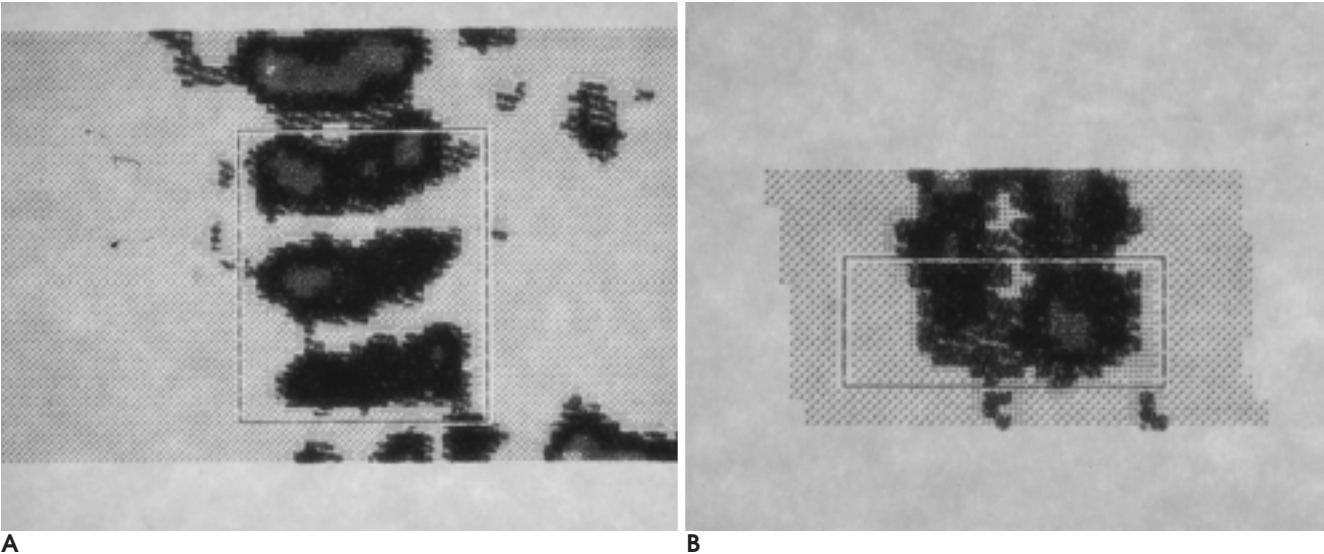
student t - test

**Table 2.** Correlation Coefficients of Bone Mineral Density versus Conceptional Age and Birth Weight on Preterm Infants

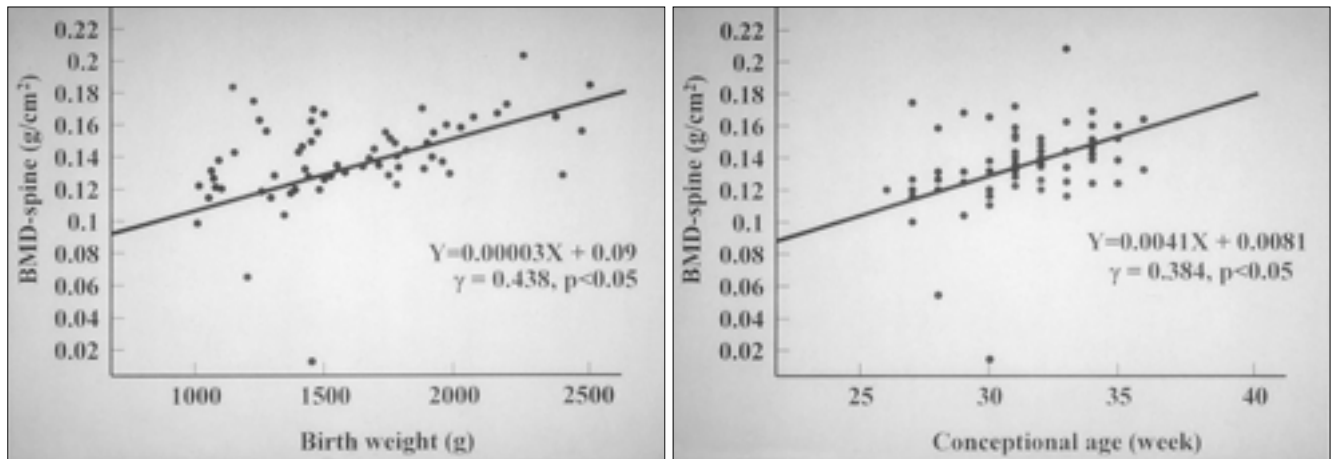
		Conceptional age at birth	Birth weight
BMD-spine	r value	0.384**	0.438**
	p value	0.001	0.000
BMD-wrist	r value	0.223	0.281*
	p value	0.068	0.020

\* correlation is significant at the 0.05 level

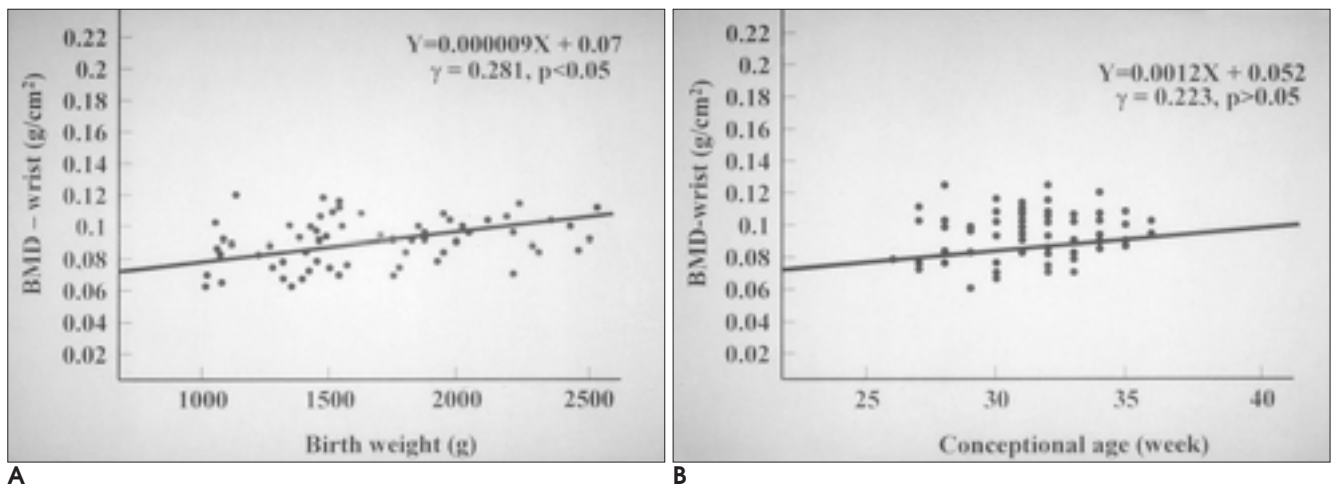
\*\* correlation is significant at the 0.01 level



**Fig. 1.** Representative scan image of lumbar spine (A) and wrist (B) in preterm infant. The subject is a female infant (conceptional age 31weeks, birth weight 2250 g) with corrected age 0. Bone mineral density of lumbar spine is 0.135 g/cm<sup>2</sup> and that of wrist is 0.085 g/cm<sup>2</sup>.



**Fig. 2.** Correlation of lumbar spine-BMD with birth weight (**A**) and conceptional age (**B**). The lumbar spinal BMD correlated significantly with birth weight ( $r = 0.438$ ,  $p < 0.05$ ) and conceptional age ( $r = 0.384$ ,  $p < 0.05$ ).



**Fig. 3.** Correlation of wrist-BMD with birth weight (**A**) and conceptional age (**B**). The wrist BMD correlated significantly with birth weight ( $r = 0.281$ ,  $p < 0.05$ ) but did not correlate significantly with conceptional age ( $r = 0.223$ ,  $p > 0.05$ ).

55  
( $r = 0.167$ ,  $p = 0.223$ ;  $r = 0.080$ ,  $p = 0.563$ ),  
( $r = 0.064$ ,  $p = 0.642$ ;  $r = -0.029$ ,  $p = 0.835$ ), alkaline phos-  
phatase ( $r = -0.158$ ,  $p = 0.248$ ;  $r = -0.098$ ,  $p = 0.447$ )

가

19).

가

(4, 6, 9).

, , alkaline phosphatase

(1,

10),

13 - 32%

(1),

(5, 7, 13 - 15).

DEXA

0.214 ±

0.030 g/cm<sup>2</sup> (0.160 - 0.296 g/cm<sup>2</sup>) Brailion (2)

DEXA

0.268

가

(1, 8, 12, 16 -

± 0.030 g/cm<sup>2</sup> (0.227 - 0.307 g/cm<sup>2</sup>) Tsukahara (4)

0.306 ± 0.019 g/cm<sup>2</sup> (0.262 - 0.331 g/cm<sup>2</sup>)

1 5 (2) 1

4 (4)

2 4 가 ,

가

0.118 ± 0.014 g/cm<sup>2</sup> (0.096 - 0.162 g/cm<sup>2</sup>)

DEXA

가 가

0

0.137 ± 0.018 g/cm<sup>2</sup>, 0.089 ± 0.013 g/cm<sup>2</sup> (p < 0.05).

가

(1, 2, 8, 12). (12)

가

(linear relationship)

가 (r = 0.281, p < 0.05),

(r = 0.223, p > 0.05).

0 , , alkaline phosphatase

phatase , James (20) alkaline phosphatase

가

가

가

80%가

(1 - 4, 17, 20 - 22).

가 (total parenteral nutrition),

DEXA

0.214 ± 0.030 g/cm<sup>2</sup> (0.160 - 0.296 g/cm<sup>2</sup>)

0.118 ± 0.014 g/cm<sup>2</sup> (0.096 - 0.162 g/cm<sup>2</sup>)가

가 0

2/3

3/4

가

0

1. Glastre C, Braillon P, David L, Cochat P, Meunier PJ, Delmas PD. Measurement of bone mineral content of spine by dual energy X-ray absorptiometry in normal children: correlations with growth parameters. *J Clin Endocrinol Metab* 1990;70:1330-1333
2. Braillon PM, Salle BL, Brunet J, Glorieux FH, Delmas PD, Meunier PJ. Dual energy X-ray absorptiometry measurement of bone mineral content in newborns : validation of the technique. *Pediatr Res* 1992;32:77-80
3. Henderson RC. Assessment of bone mineral content in children. *J Pediatr Orthop* 1991;11:314-317
4. Tsukahara H, Sudo M, Umezaki M, et al. Measurement of lumbar spinal bone mineral density in preterm infants by dual energy X-ray absorptiometry. *Biol Neonate* 1993;64:96-103
5. Behrman RE, Kligman RM, Arvin AM. *Rickets of vitamin D deficiency in nutritional disorders*. In Nelson WE. *Textbook of pediatrics*, 15th ed. Philadelphia : Saunders, 1996:179-183
6. Lang P, Steiger P, Faulkner K, Gluer C, Genant HK. Osteoporosis. *Radiol Clin North Am* 1991;29:49-76
7. Koo WWK, Gupta JM, Nayanar VV, Wilkinson M, Posen S. Skeletal changes in preterm infants. *Arch Dis Child* 1982;57:447-452
8. Grampp S, Jergas M, Gluer CC, Lang P, Brastow P, Gennant HK. Radiologic diagnosis of osteoporosis. *Radiol Clin North Am* 1993;31:1133-1145
9. Faulkner KG, Gluer CC, Majumdar S, Lang P, Engelke KE, Gennant HK. Noninvasive measurements of bone mass, structure and strength : current methods and experimental techniques. *AJR Am J Roentgenol* 1991;157:1229-1237
10. Yochum TR, Rowe LJ. *Nutritional, metabolic and endocrine disorders. Essentials of skeletal radiology* 2nd ed. Baltimore: Williams & Wilkins, 1996:1327-1370
11. Steichen JJ, Gratton TL, Tsang RC. Osteopenia of prematurity: the cause and possible treatment. *J Pediatr* 1980;96:528-534
12. 1997;36:337-342
13. Kovar I, Mayne P. Plasma alkaline phosphatase activity in the preterm neonate. *Acta Paediatr Scand* 1981;70:501-506
14. Pittard WB, Geddes KM, Hursely TC, Hollis BW. Osteocalcin, skeletal alkaline phosphatase, and bone mineral content in very low birth weight infants : a longitudinal assessment. *Pediatr Res* 1992;31:181-185
15. Kroger H, Kotaniemi A, Vainio P, Alhava E. Bone densitometry of the spine and femur in children by dual energy X-ray absorptiometry. *Bone Miner* 1992;17:75-85
16. Hansen MA, Hassager C, Overgaard K, Marslew U, Riis BJ, Christiansen C. Dual energy X-ray absorptiometry: A precise method of measuring bone mineral density in the lumbar spine. *J Nucl Med* 1990;31:1156-1162
17. Forbes GB. Some remarks on bone mineralization. *J Pediatr* 1988;113:167-171
18. Sartoris DJ, Resnick D. Dual energy radiographic absorptiometry for bone densitometry: current status and perspective. *AJR Am J Roentgenol* 1989;152:241-246
19. Barden HS, Mazess RB. Bone densitometry in infants. *J Pediatr*

- 1988; 113(suppl):172-177
20. James JR, Congdon PJ, Truscott J, Horsman A, Arthur R. Osteopenia of prematurity. *Arch Dis Child* 1986;61:871-876
21. Kulkarni PB, Hall RT, Rhodes PG, et al. Rickets in very low birth

- weight infants. *J Pediatr* 1980;96:249-252
22. Callenbach JC, Sheehan MB, Abramson SJ, Hall RT. Etiologic factors in rickets of very low-birth-weight infants. *J Pediatr* 1981;98:800-805

## The Difference of Bone Mineral Density of Lumbar Spine and Wrist in the Preterm and Full-term Infants: Using Dual Energy X-ray Absorptiometry<sup>1</sup>

Min Jung Cha, M.D., Seung Cheol Kim, M.D., Young Seok Lee, M.D.,  
Young Pyo Chang, M.D.<sup>2</sup>, Jin-Young Park, M.D.<sup>3</sup>

<sup>1</sup>Department of Diagnostic Radiology, Dankook University Hospital, College of Medicine

<sup>2</sup>Department of Pediatrics, Dankook University Hospital, College of Medicine

<sup>3</sup>Department of Orthopedic Surgery, Dankook University Hospital, College of Medicine

**Purpose:** To assess the differences in bone mineral density (BMD) of lumbar spine and wrist between preterm infants of postconceptional age 40 weeks and normal full-term infants.

**Materials and Methods:** Sixty-eight preterm infants born at conceptional age 26 - 36 weeks and 31 normal full-term infants born at 38 - 42 weeks were investigated. Bone mineral densities of the lumbar spine (from the second to the fourth segment) and wrist were measured by dual energy X-ray absorptiometry. In preterm infants, the corrected age of 0 month was defined as postconceptional 40 weeks. Full-term infants were evaluated within three days of birth, and the average bone mineral densities of preterm and full-term infants were compared. In the preterm group, birth weight and conceptional age were correlated with lumbar spinal and wrist bone mineral densities. Data were analyzed by student's *t*-test and Pearson's correlation coefficient, and a *p* value of less than 0.05 was considered significant.

**Results:** In preterm infants, the values of bone mineral densities of the lumbar spine and wrist were  $0.137 \pm 0.018$  g/cm<sup>2</sup> (0.061 - 0.202 g/cm<sup>2</sup>) and  $0.089 \pm 0.013$  g/cm<sup>2</sup> (0.065 - 0.123 g/cm<sup>2</sup>), respectively, while the respective values for full-term infants were  $0.214 \pm 0.030$  g/cm<sup>2</sup> (0.160 - 0.296 g/cm<sup>2</sup>) and  $0.118 \pm 0.014$  g/cm<sup>2</sup> (0.096 - 0.162 g/cm<sup>2</sup>). In the preterm group, lumbar spinal BMD correlated significantly with conceptional age ( $r = 0.384$ ,  $p < 0.05$ ) and birth weight ( $r = 0.438$ ,  $p < 0.05$ ). While wrist BMD correlated significantly with birth weight ( $r = 0.281$ ,  $p < 0.05$ ), its correlation with conceptional age was not significant ( $r = 0.223$ ,  $p > 0.05$ ).

**Conclusion:** The lumbar spinal and wrist BMDs of preterm infants at corrected age 0 were lower than those of normal full-term infants. In the preterm group, BMD values for the lumbar spine were lower in infants of lower conceptional age and birth weight.

**Index words :** Bones, absorptiometry  
Bones, mineralization  
Bone density  
Infants, newborn, skeletal system

Address reprint requests to : Seung Cheol Kim, M.D., Department of Diagnostic Radiology, Dankook University Hospital, College of Medicine, 29 Anseodong Chonan Choongnam, 330-715, Korea.  
Tel. 82-41-550-6921 Fax. 82-41-552-9674 E-mail: kimschl@anseodankook.ac.kr

**MEDICAL DESIGN & MANUFACTURING (MD&M)  
MINNEAPOLIS CONFERENCE AND EXPOSITION  
(2000 10 25-26 )**

venue: Convention Center, Minneapolis, Minnesota, USA.  
contact: Gretchen Hawley, Canon Communications LLC,  
11444 W. Olympic Blvd., Ste 700, Los Angeles, CA  
90064-1549, USA.  
(tel: 1-310-9969447; fax: 1-310-9969449;  
E-mail: gretchen.hawley@cancom.com)

**7TH ANNUAL MEETING EUROPEAN SOCIETY OF  
MUSCULO-SKELETAL RADIOLOGY (ESSR)  
(2000 10 27-28 )**

venue: Leiden, The Netherlands.  
contact: Dr. W. R. Obermann, Prof. J. L. Bloem, Leiden  
University Medical Ctr.,  
Dept. of Radiology, C2-S, Albinusdreef 2, NL-2333  
AZ Leiden, The Netherlands.  
(tel: 31-71-5261913; fax: 31-71-5248256;  
E-mail: bloem@radiology.azl.nl)

**FIFTH INTERNATIONAL SYMPOSIUM ON  
CARDIOVASCULAR AND INTERVENTIONAL  
RADIOLOGY (2000 11 5-9 )**

venue: Seaport Boston Hotel, Boston, MA, USA.  
contact: Danielle Pokorski, Dept. of Radiology,  
75 Francis Street, Boston, MA 02115, USA.  
(tel: 1-617-7326265; fax: 1-617-7326509)

**PRACTICAL TRAINING IN INTERVENTIONAL  
RADIOLOGY COURSE (2000 11 6-10 )**

venue: Univ. Hosp. Sart Tilman, Liège, Belgium.  
contact: Prof. R. F. Dondelinger, Univ. Hosp. Sart Tilman,  
Domaine du Sart Tilman B35, B-4000 Liège 1,  
Belgium.  
(tel: 32-4-3667259; fax: 32-4-3667224;  
E-mail: rdondelinger@chu.ulg.ac.be)

**51ST ANNUAL SESSION OF THE AMERICAN ACADEMY  
OF ORAL AND MAXILIOFACIAL RADIOLOGY  
(2000 11 8-12 )**

venue: Double Tree Nashville Hotel, Nashville, TN, USA.  
contact: Dr. M. Kevin O Carroll, Executive Secretary,  
P. O. Box 55722, Jackson, MS 39296, USA.  
(tel: 1-601-9846060; fax: 1-601-9846086;  
E-mail: mocarroll@sod.umsmed.edu)

**86TH MEETING RADIOLOGICAL SOCIETY OF NORTH  
AMERICA (RSNA) (2000 11 26 -12 1 )**

venue: McCormick Place, Chicago, USA.  
contact: Steven T. Drew, Ass. Executive Director,  
820 Jorie Boulevard, Oak Brook, IL 60523-2251,  
USA.  
(tel: 1-630-5717879; fax: 1-630-5717837;  
E-mail: sdrew@rsna.org)

**32ND ANNUAL SCIENTIFIC CONFERENCE AND  
EXHIBITION OF THE BRITISH MEDICAL ULTRASOUND  
SOCIETY (BMUS) (2000 12 6-8 )**

venue: Devonshire Park Centre, Eastbourne, United  
Kingdom.  
contact: Mrs. Elaine Brown, General Secretary BMUS,  
36 Portland Place, London WIN 3DG, United  
Kingdom.  
(tel: 44-171-6363714; fax: 44-171-3232175;  
E-mail: B.M.U.S@compuserve.com)

**INTERNATIONAL ENDOVASCULAR SYMPOSIUM  
(2000 12 10-12 )**

venue: Sydney, Australia.  
contact: Ms Margaret Blackwell, Abacus Management,  
P. O. Box 77, Pymble NSW 2073, Australia.