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Abstract

Effects of Intramedullary Vascularized Muscle Flap in Regeneration of Lyophilized, Autografted Humeral Head in Rabbits

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The aim of this study was to assess whether the functional regeneration of a lyophilized autografted cartilage could be improved by implanting a vascularized muscle flap into the medullary canal of autografted proximal humerus.

A hemijoint reconstruction using a lyophilized osteochondral autograft in proximal humerus was done in 4 rabbits for control, and combined with an vascularized intramedullary muscle flap in another 4 rabbits for the experimental group. Graft healing and the repair process of osteochondral graft were followed by serial radiographs and histologic changes for 9 weeks after experiments. Each two rabbits in control and in experimental group on 5th and 9th week after implantation of hemijoint were sacrificed.

The results were as follows:

1. All of control and experimental groups on 5th week united solidly on osteotomized site radiologically, but their articular cartilages were destroyed more seriously in the control than that in experimental group with muscle flap on 5th and 9th week after experiment...
2. Histochemically, the cartilage surface are completely destroyed and revealed with severe osteoarthritic changes on all cartilage layers in control, but cartilaginous erosions are mild to moderate and their arthritic changes are also mild with somewhat regeneration of chondrocytes on deep layers more prominently on 9th week of the experimental group.
3. The amount of collagen and proteoglycan matrix which was determined by Masson-Trichrome stain was markedly decreased that means the weakness of bony strength and low osteogenic potential in lyophilized cartilage.

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-70 (Liquid N₂)

4 100% ethanol 20

1 4

(rotator cuff)

가 2

4 1

(lateral thoracic artery) (pedicle)

15cm

drill 1cm

(Fig. 1),

(Fig.

2).

1 4

, gentamicin 40mg

3

3.

1)

5

8 , 9

4 2



Fig. 1. Intramedullary muscle flap attached with lateral thoracic artery inserted on proximal humerus of rabbit.

2)

5 9

2

10% formalin 1

Hematoxylin-eosin

Trichrome (stainability)

(bone cortex) (collagen)

(mechanical strength)

(osteogenic potential)

1.

1)

5 3

(sclerosis) (collapse) (Fig. 2-가

(Fig. 2-B)

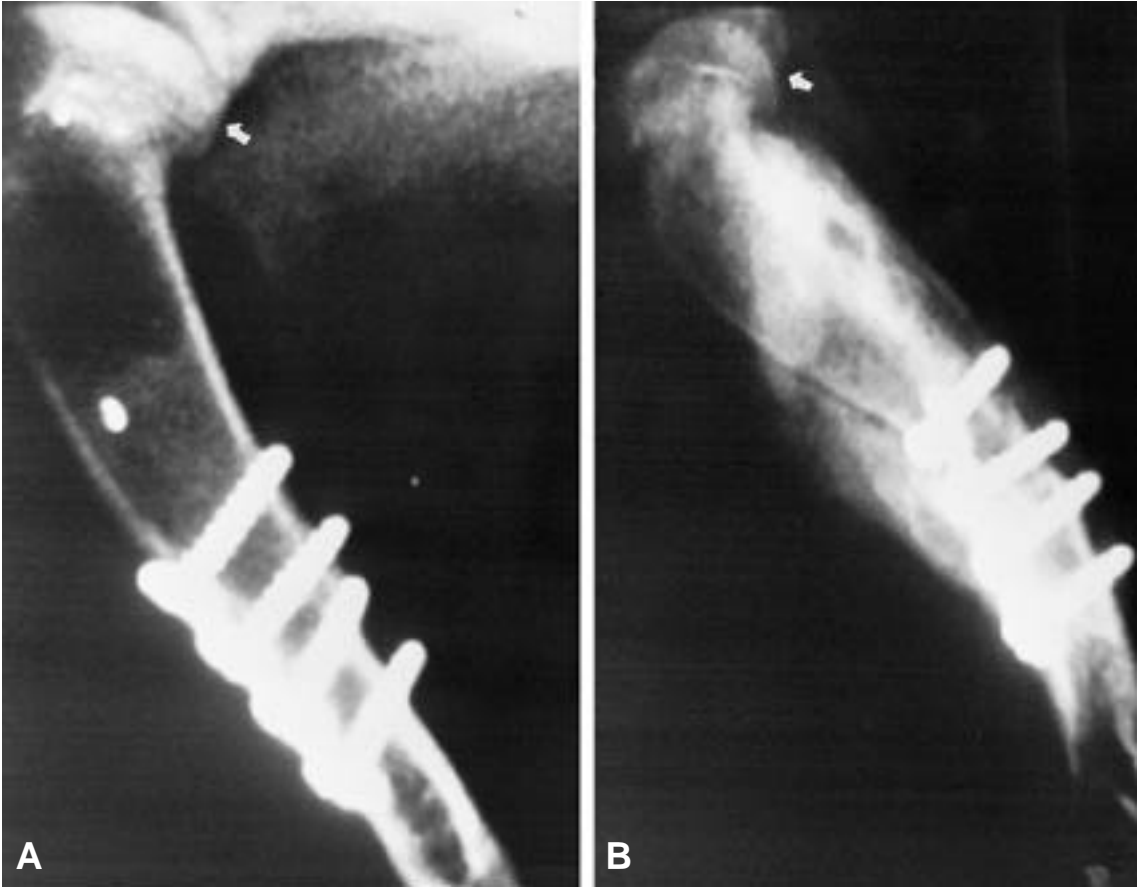


Fig. 2-A. Scanty callus on osteotomy site and collapsed humeral head are shown on 5th week of the control group.
B. Huge callus in osteotomy site, more sclerotic medullary canal and normal humeral head are shown on 5th week of the experimental group.

2. (stainability) 가 (Fig. 4-A)
 5 9 가 ,
 (Fig. 3-A), (Fig. 4-B).
 (outer cortex) .
 (Fig. 3-B), 197
 (quick freeze-slow thaw)
 5 , 9 ⁶⁾, -21 ^{18,19)},
 Masson-Trichrome stain (cytotoxicity),

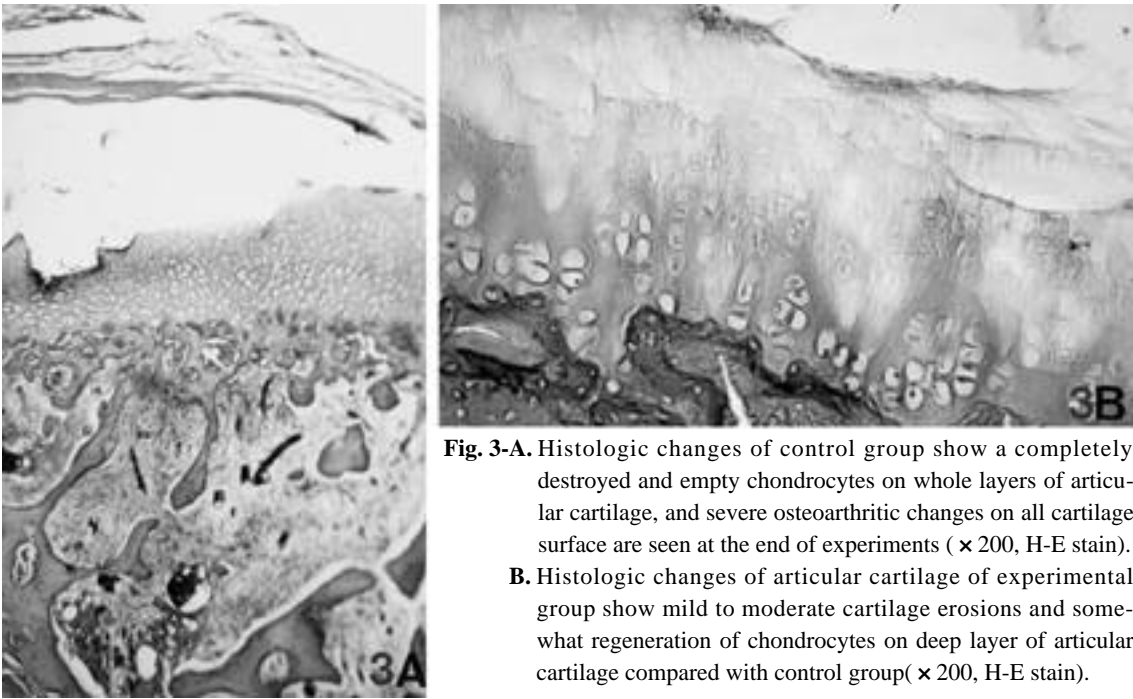


Fig. 3-A. Histologic changes of control group show a completely destroyed and empty chondrocytes on whole layers of articular cartilage, and severe osteoarthritic changes on all cartilage surface are seen at the end of experiments (× 200, H-E stain).
B. Histologic changes of articular cartilage of experimental group show mild to moderate cartilage erosions and somewhat regeneration of chondrocytes on deep layer of articular cartilage compared with control group(× 200, H-E stain).

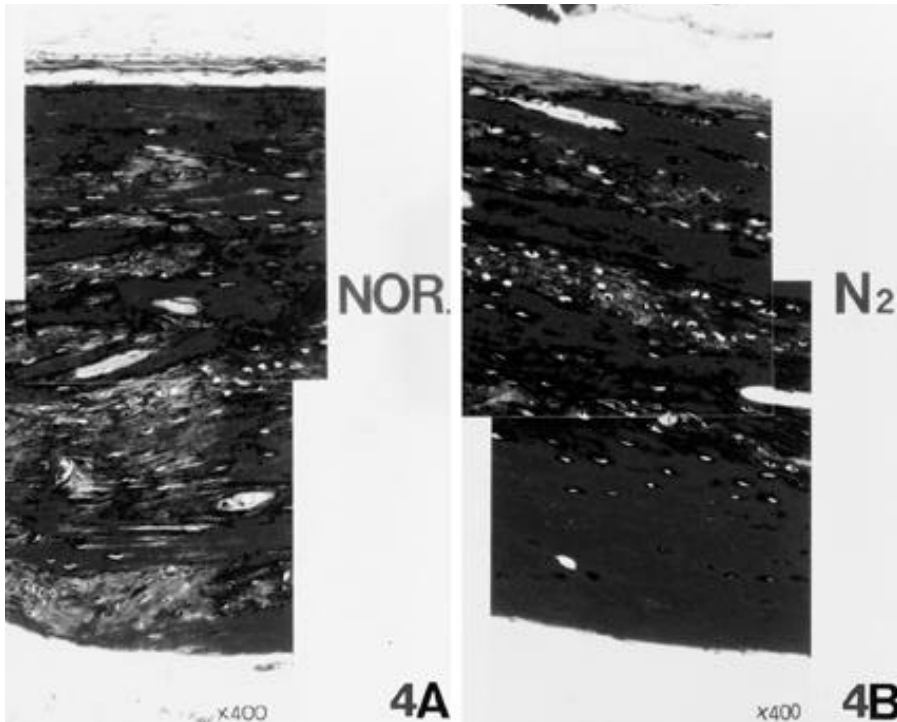


Fig. 4-A. The cortex of long bone of the control group with Masson-Trichrome stain(× 400) show an extensive stainability with blue color meaning the normal amount of collagen matrix in it.
B. The cortex of lyophilized long bone with Masson-Trichrome stain(× 400) show much more faint stainability with blue color meaning the low content of collagen matrix compared with than that of normal bone.

11,12,16)

(lyophilization, cryosurgery)

1850 Jame Arnott¹⁾가

1991 Malawar ¹¹⁾ benign-aggressive, low-grade malignant bone tumor

15,18)

(Kienbock)

2cm 7~12mm 가, 3 가, 1 가 12,14)

Hasegawa ⁷⁾

(Fig. 4)

(vascularized iliac pedicle bone graft)

8

, Leung¹⁰⁾

가

Kawai ⁹⁾

8

Forgon Montsk⁵⁾

43%

2

가

가

O'Connor ¹⁷⁾

50%

3~5

3~5

. Delloye

4)

(outer cortex) 1/3

가

가

5

9

가

5

(diffusion)

가

가

가
 (diffusion) (subchondral bone)

가
 5 9 2 X-
 1. 9
 2.
 3.
 가
 가
 -
 가

REFERENCES

Brown Khouri³⁾

- 1) 가 : , 30(5):1308-1312, 1995
- 2) Arnot JM : *Practical illustrations of the remedial efficiency of a very low anaesthetic temperature in cancer. Lancet* 1850; 2: 257-316.
- 3) Brown DM, Khouri RK : *Custom fabrication of vascularized bone grafts using osteoinductive transforming factors. Surg Forum*, 41:593, 1990.
- 4) Delloye C, de Nayer P, Allington N, Munting E, Coutelier L, Vincent A : *Massive bone allografts in large skeletal defects after tumor surgery: a clinical and micro-radiographic evaluation. Arch Orthop Trauma Surg*, 107:31-41, 1988.
- 5) Forgon M, Montsko P : *Muscle-pedicle grafts or muscle-pedicle-bone grafts in the treatment for avascular necrotic femoral heads. Arch Orthop Trauma Surg*, 115:223-226, 1995.
- 6) Gill W, Fraser J, Carter D C : *Repeated freeze-thaw cycles in cryosurgery. Nature*, 219:410-3, 1968.

2/3 -70
 100% ethanol , 1 4
 , 2 4

- 7) Hasegawa Y, Iwata H, Torri S, Iwase T, Kawamoto K, Iwasada S : *Vascularized pedicle bone-grafting for non-traumatic avascular necrosis of the femoral head A 5 to 11 year follow-up. Arch Orthop Trauma Surg, 116:251-258, 1997.*
- 8) Hoeffner EG, Ryan JR, Qureshi F, Soulen RL : *Magnetic resonance imaging of massive bone allografts with histologic correlation. Skeletal Radiol, 25:165-170, 1996.*
- 9) Kawai A, Muschler GF, Lane JM, Otis JC, Healey JH : *Prosthetic knee replacement after resection of a malignant tumor of the distal part of the femur. J Bone Joint Surg, 80-A:636-647, 1998.*
- 10) Leung PC : *Femoral head reconstruction and revascularization. Clin Orthop, 323:139-145, 1996.*
- 11) Malawer MM, Dunham W : *Cryosurgery and acrylic cementation as surgical adjuncts in the treatment of aggressive (begin) bone tumors. Analysis of 25 patients below the age of 21. Clin Orthop, 262:42-57, 1991.*
- 12) Malawer MM, Marks MR, McChesney D, Piasio M, Gunther SF, Shmoolker BM : *The effect of cryosurgery and polymethylmethacrylate in dogs with experimental bone defects comparable to tumor defect. Clin Orthop, 226:299-310, 1988.*
- 13) Malawer MM, Bickels J, Meller I, Buch R, Kollender Y : *Cryosurgery in the treatment of giant cell tumor. A long term follow up study. In press. Clin Orthop 1999.*
- 14) Marcove RC, Weis LD, Baghaiwalla MR : *Cryosurgery in the treatment of giant cell tumor of bone. A report of 52 consecutive cases. Cancer, 41:957-69, 1978.*
- 15) Marcove RC, Sheth DS, Takemoto S, Healey JS : *The treatment of aneurysmal bone cyst. Clin Orthop, 311:157-63, 1995.*
- 16) Miller RH, Mazur P : *Survival of frozen-thawed human red cells as a function of cooling and warming velocities. Cryobiology, 13:404-14, 1976.*
- 17) O'Connor M, Sim FH, Chao EY : *Limb salvage for neoplasm of the shoulder girdle. J Bone Joint Surg, 78-A:1872-1888, 1996.*
- 18) Schreuder HW, Pruszczynski M, Veth RP, Lemmens JA : *Treatment of benign and low-grade malignant intramedullary chondroid tumours with curettage and cryosurgery. Eur J Surg Oncol, 24:120-6, 1998.*
- 19) Schreuder HW, van Egmond J, van Beem JB, Veth RP : *Monitoring during cryosurgery of bone tumors. J Surg Oncol, 65:40-5, 1997.*
- 20) Wassenaar RP, Verburg H, Taconis WK, van der Eijken JW : *Avascular osteonecrosis of the femoral head treated with a vascularized iliac bone graft: preliminary results and follow-up with radiography and MR imaging. Radiographics, 16(3):585-593, 1996.*
- 21) Weiland AJ : *Vascularized free bone transplants. J Bone Joint Surg, 63-A:166-169, 1981.*