

Core Decompression with Bone Marrow Injection for the Treatment of Femoral Head Osteonecrosis

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Background: Core decompression has been recommended in treatment of non-traumatic femoral head necrosis in early stage. Injection with patient's own bone marrow from the iliac crest might promote bone formation in the femoral head.

Objective: To evaluate the result of patients treated by this technique.

Material and Method: Retrospective review of a series of cases by the medical records and radiographic pictures.

Results: There were 34 procedures from 32 patients. Mean follow-up time was 24.6 months in stage 2 and 27.8 months in stage 3. Radiographic progression was observed in 76% and 69% of stage 2 and 3. Twenty one percent of stage 2 hips underwent other surgeries when 46% of stage 3 did at last follow-up. Pain relief was observed in all cases after the surgery.

Conclusion: The proposed technique yielded only fair results. Probably due to most patients had steroid related pathology.

Keywords: Core decompression, Avascular necrosis of the femoral head, Bone marrow injection

J Med Assoc Thai 2014; 97 (Suppl. 9): S139-143

Full text. e-Journal: <http://www.jmatonline.com>

Osteonecrosis of femoral head is a common cause collapsed of femoral head and destruction of the hip joint, resulting in disability and leading to total hip arthroplasty in young adults⁽¹⁻⁴⁾. Many techniques of joint-preserving procedures have been proposed. Ficat and Arlet⁽⁵⁾ who described the 4 stages of the condition, reported a series of the patient treated with core decompression of the femoral head.

The procedure based on the rational of reducing the bone marrow pressure and allowing new blood supply in to the necrotic area of the femoral head. Recent technique is a single entrance hole of 3.5 mm drilled from the lateral cortex of the proximal femur to the necrotic area of the head.

The core decompression is recommended in early stage of disease with the success rate of 84% in stage 1 and 65% in stage 2. It appears to be unpredictable and not recommended if the disease is beyond stage 2^(5,6). Hernigou⁽⁷⁾ proposed the use of concentrated bone marrow grafting with the core decompression. The technique requires a process of obtaining large amount of bone marrow (150 cc) harvested from the patient at the beginning of the procedure. The marrow

was then processed into a high concentrated bone marrow and then infused to the necrotic area of the femoral head through the core hole. Even the result of the procedure appeared to be promising it is not practical in common orthopaedic practice. Therefore a simple bone marrow aspiration injected into the femoral head was attempted in a series of patients with non-traumatic osteonecrosis. Although the core decompression is not recommended in stage 3 patient, the technique was attempted due to usual late presentation of the patient.

Material and Method

Patients with diagnosis of stage 2, 3 non-traumatic osteonecrosis of the femoral head from June 2005 to June 2010 were included in this study. Patients with incomplete medical record were excluded from the study. Demographic data of the patients including of age, sex, underlying disease, risk factor of osteonecrosis were reviewed and analysed. The operative procedure was performed by drilling an entrance hole with a 3.5 mm. drill bit at the lateral aspect of proximal femur just below the vastus ridge of the greater trochanter into the necrotic lesion of the head. The autologous bone marrow of 12 cc was aspirated from iliac crest by a small drill hole and injected into the femoral head through the core hole by using a bone biopsy needle. After the injection, the entrance hole is obliterated by directing the core needle tangentially in order to collapse the

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core hole by cancellous bone to prevent leakage of the bone marrow (Fig. 1).

Postoperative program consisted of six weeks of non-weight bearing with axillary crutches. The patients were followed at 3 months, 6 months, 1 year and yearly. Radiographic data of the femoral head were observed in each visit. A visual analog scale was used to evaluate the pain score at each follow-up visit.

Results

There were 34 procedures performed on 32 patients (14 females, 18 males) with a mean age of 31.9 years old (range 14-54). The limb-specific involvements were 16 right hips and 18 left hips. 21 hips were classified in stage 2, 13 in stage 3, according to Ficat and Arlet classification (Table 1).

In stage 2 patients, 16 were steroid related (84.2%) 9 had diagnosis of SLE. Only 2 patients were idiopathic in etiology (Table 2).

In stage 3 patients, 10 were steroid related (76.9%). 3 were idiopathic (Table 3).

At one year follow-up, 14 stage 2 and 5 stage 3 hip had radiographic progression (66% and 38% respectively). However at two years follow-up 16 stage 2 hips, 9 stage 3 hips had radiographic progression (76% and 69%) (Table 4).

By last follow-up, 2 patients with stage 2 disease died without having total hip replacement at 3 years, 5 years follow-up due to infection not related to the osteonecrosis of femoral head. 4 hips had total hip

replacements due to pain and disability (4/19 = 21%). 6 stage 3 hips had 5 total hip replacements, one free fibular graft (46%) (Table 5). There were 12/21 (57%) hips in stage 2 showed evidence of bone formation in the necrotic area of the femoral head. There were only 5/13 (38.4%) hips in stage 3 showed this bone formation (Fig. 2, 3).

There was improvement of the average pain score (visual analog scale) from pre operative score compared to one year post operative score in both stage 2 and 3 hips (Table 6).

Discussion

Osteonecrosis of femoral head is a hip disorder that affected young patients in third to fifth decade of life. Joint-preserving procedures including core decompression, osteotomies, nonvascularized and vascularised bone graft were reported success in many reports⁽⁸⁻¹⁰⁾. Core decompression was proposed to reduce bone marrow pressure and induced neovascularization. Later, bone marrow grafting was injected in order to increase bone remodelling by progenitor cells from healthy marrow.

The current study was done to report the result of core decompression with bone marrow injection which different from previous reports using concentrated bone marrow for injection⁽¹¹⁻¹⁴⁾. The benefit of this technique was a simple procedure that could be performed at the time of surgery and no need for the concentration process. The result of the current study revealed 76% and 69% of stage 2 and 3 hips had progression at 2 years follow-up. 21% and 67% of stage 2 and 3 hips had undergone other surgeries. The rate of failure was higher than reported in other literatures⁽¹¹⁻¹³⁾. This is possible due to the amount and concentration of progenitor cells in the injected marrow was less than in concentrated bone marrow. Another factor that may result in poor result was steroid usage (84.2% in stage 2 patients and 76.9% in stage 3 patients). However there were evidence that showed bone formation in the lesion of the femoral head even the disease had progress (67% in stage 2 and 38.4% in stage 3).

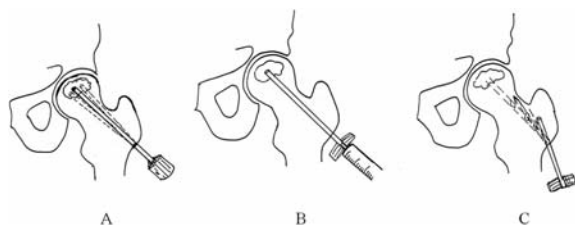


Fig. 1 Show core decompression technique with bone marrow injection. A) 3.5 mm drill bit was used with 2-3 passes into the lesion, B) Injection of the bone marrow by using a bone biopsy needle, C) Collapse the cancellous bone to close the core hole.

Table 1. Showed number of patients, procedure, sex, side, average age and average time of follow-up

	Patients	M/F	Procedure (hips)	R/F	Age	Follow-up
Stage 2	19	6/13	21	11/10	36.1 (14-53)	24.6 m
Stage 3	13	5/8	13	5/8	32 (17-54)	27.8 m

Table 2. Diagnosis in patients with stage 2

Diagnosis	Number of patients
SLE	9
Nephrotic Syndrome	2
SJS*	1
Asthma	1
Myasthenia gravis	1
Alcoholic	1
Bachet's	1
Vocal cord nodule (treated with steroid)	1
Idiopathic	2
Total	19

(*SJS = Stevens Johnson Syndrome)

Table 3. Diagnosis in patients with stage 3

Diagnosis	Number of patients
SLE	7
Myasthenia gravis	2
Brain tumor (treated with steroid)	1
Idiopathic	3
Total	13

Table 4. Showed the percentage of radiographic progression in stage 2, 3 hips at one year and two years follow-up

	1 year	2 year
Stage 2	66% (14/21)	76% (16/21)
Stage 3	38% (5/13)	69% (9/13)

Table 5. Showed the number of surgical procedure (total hip replacement and free fibular graft) by last follow-up

	Surgical procedure	
Stage 2	21% (4/19)	2 deaths at 3, 5 year
Stage 3	46% (6/13)	1 free fibular graft

Table 6. showed improvement of the average pain score from pre operation to post operation in patients who did not have additional surgical procedure

	Pre op	1m	3m	6m	1yr
Stage 2	6.1	2.5	1.8	2.4	1.6
Stage 3	7.3	4.2	2.5	3	3



Fig. 2 29 year-old female with underlying disease of SLE. She had osteonecrosis of the femoral head, Stage 2 on the left side (A, B). She underwent core decompression with bone marrow injection. Five years later her radiograph revealed sclerotic change without femoral head collapse (C, D).



Fig. 3 38 year-old female with steroid usage due to SLE: A) Patient presented with osteonecrosis stage 3 of the left hip and underwent a core decompression with bone marrow injection. B) Five years later, patient radiograph showed cystic formation with sclerosis of the femoral head without further collapse.

Pain reduction after surgery was observed in the first month after surgery and maintain to at least 1 year. This may due to the reduction of bone marrow

pressure from the procedure.

Limitation of the present study was small number of patients.

Conclusion

The technique of core decompression with bone marrow injection presented in the present study yielded only fair result in stage 2 and 3 patients. New technique should be developed for osteonecrosis of the femoral head especially in steroid related patients.

Potential conflicts of interest

None.

References

1. Mont MA, Hungerford DS. Non-traumatic avascular necrosis of the femoral head. *J Bone Joint Surg Am* 1995; 77: 459-74.
2. Assouline-Dayana Y, Chang C, Greenspan A, Shoenfeld Y, Gershwin ME. Pathogenesis and natural history of osteonecrosis. *Semin Arthritis Rheum* 2002; 32: 94-124.
3. Mont MA, Zywielski MG, Marker DR, McGrath MS, Delanois RE. The natural history of untreated asymptomatic osteonecrosis of the femoral head: a systematic literature review. *J Bone Joint Surg Am* 2010; 92: 2165-70.
4. Mont MA, Jones LC, Seyler TM, Marulanda GA, Saleh KJ, Delanois RE. New treatment approaches for osteonecrosis of the femoral head: an overview. *Instr Course Lect* 2007; 56: 197-212.
5. Ficat RP. Idiopathic bone necrosis of the femoral head. Early diagnosis and treatment. *J Bone Joint Surg Br* 1985; 67: 3-9.
6. Castro FP Jr, Barrack RL. Core decompression and conservative treatment for avascular necrosis of the femoral head: a meta-analysis. *Am J Orthop (Belle Mead NJ)* 2000; 29: 187-94.
7. Hernigou P, Beaujean F. Treatment of osteonecrosis with autologous bone marrow grafting. *Clin Orthop Relat Res* 2002; (405): 14-23.
8. Mont MA, Etienne G, Ragland PS. Outcome of nonvascularized bone grafting for osteonecrosis of the femoral head. *Clin Orthop Relat Res* 2003; (417): 84-92.
9. Fang T, Zhang EW, Sailes FC, McGuire RA, Lineaweaver WC, Zhang F. Vascularized fibular grafts in patients with avascular necrosis of femoral head: a systematic review and meta-analysis. *Arch Orthop Trauma Surg* 2013; 133: 1-10.
10. Lieberman JR, Conduah A, Urist MR. Treatment of osteonecrosis of the femoral head with core decompression and human bone morphogenetic protein. *Clin Orthop Relat Res* 2004; (429): 139-45.
11. Chang T, Tang K, Tao X, Cao H, Li H, Chen Q, et al. Treatment of early avascular necrosis of femoral head by core decompression combined with autologous bone marrow mesenchymal stem cells transplantation. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi* 2010; 24: 739-43.
12. Gangji V, De Maertelaer V, Hauzeur JP. Autologous bone marrow cell implantation in the treatment of non-traumatic osteonecrosis of the femoral head: Five year follow-up of a prospective controlled study. *Bone* 2011; 49: 1005-9.
13. Wang BL, Sun W, Shi ZC, Zhang NF, Yue DB, Guo WS, et al. Treatment of nontraumatic osteonecrosis of the femoral head with the implantation of core decompression and concentrated autologous bone marrow containing mononuclear cells. *Arch Orthop Trauma Surg* 2010; 130: 859-65.
14. Chotivichit A, Korwutthikulrangsri E, Auwarakul C, Sarirasririd S. Core decompression and concentrated autologous bone marrow injection for treatment of osteonecrosis of the femoral head. *J Med Assoc Thai* 2012; 95 (Suppl 9): S14-20.

การรักษาภาวะหัวใจกระดูกสะโพกตายด้วยการเจาะลดความดันหัวใจกระดูกและฉีดไขกระดูก

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ภูมิหลัง: ภาวะหัวใจกระดูกสะโพกตายเป็นภาวะสำคัญที่ทำให้ต้องผ่าตัดเปลี่ยนข้อสะโพกเทียมในผู้ป่วยอายุน้อย Ficat and Arlet ได้แบ่งภาวะนี้ออกเป็น 4 ระดับ โดยแนะนำให้รักษาด้วยการเจาะโพรงหัวใจกระดูกสะโพกเพื่อระบายความดัน ซึ่งมีหลากหลายวิธีการจากการทบทวนวรรณกรรมยังไม่พบการรายงานรักษาด้วยการเจาะลดความดันและฉีดไขกระดูกแบบไม่เข็มขึ้น

วัตถุประสงค์: เพื่อรายงานผลการรักษาหัวใจกระดูกสะโพกตายโดยวิธีการเจาะแกนกลางกระดูกหัวสะโพกและฉีดไขกระดูกแบบไม่เข็มขึ้น

วัสดุและวิธีการ: ผู้นิพนธ์รวบรวมผู้ป่วย 32 รายที่ได้รับการรักษาหัวใจกระดูกสะโพกตายด้วยการเจาะแกนกลางหัวใจกระดูกสะโพกและฉีดไขกระดูกแบบไม่เข็มขึ้นตั้งแต่ พ.ศ. 2548 ถึง พ.ศ. 2553 โดยเก็บข้อมูลอายุ เพศ บัญชีเสี่ยง ของการเกิดภาวะหัวใจกระดูกสะโพกตายโรคประจำตัวผู้ป่วย โดยได้ติดตามผู้ป่วยที่ระยะเวลา 3 เดือน 6 เดือน 1 ปี และติดตามต่อปีละครั้ง โดยตรวจวัดภาพถ่ายรังสีและคะแนนความปวด

ผลการศึกษา: ผู้ป่วย 32 ราย ได้รับการผ่าตัดรักษา 34 ข้าง อายุเฉลี่ยของผู้ป่วยคือ 36.1 ปี และ 32 ปี โดยแบ่งเป็น stage 2 จำนวน 21 ข้าง stage 3 จำนวน 13 ข้าง พบปัจจัยเสี่ยงของผู้ป่วยคือ การใส่ยาสเตียรอยด์ ยากดภูมิคุ้มกัน ผู้ป่วยมีโรคประจำตัวเป็น SLE จำนวน 16 ราย และอื่นๆ อีกจำนวน 16 ราย ระยะเวลาที่ติดตามการรักษาเฉลี่ย 24.6 เดือน และ 27.8 เดือน ใน stage 2 และ 3 ผู้ป่วยทุกรายมีอาการปวดที่บรรเทาหลังรับการผ่าตัดพบว่า ข้อสะโพกใน stage 2 มีภาพถ่ายรังสีแสดงลักษณะแย่งถึง 76% ที่ 2 ปี และ 21% ได้รับการผ่าตัดเพิ่มเติม ส่วนข้อสะโพกใน stage 3 มี 69% ที่แย่งและมี 46% ได้รับการผ่าตัดเปลี่ยนข้อเทียม

สรุป: การรักษาหัวใจกระดูกสะโพกตาย ด้วยการเจาะลดความดันและฉีดไขกระดูกแบบไม่เข็มขึ้นได้ผลสำเร็จไม่ดீนนัก อาจจะเนื่องมาจากผู้ป่วยส่วนใหญ่ได้รับยา steroid จึงจำเป็นต้องหาวิธีการรักษาอย่างอื่นต่อไป
