Management approaches toward femoral head osteonecrosis

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Abstract:

This article presents a review of ONFH classification systems, current treatment options, potential therapies, surgical and nonsurgical management and the relevant barriers affecting the treatment outcome. MEDLINE, AMED, EMBASE, CINAHL, and the Cochrane Library were searched in details (for articles published up to November, 2017) for relevant articles in English language were included in the review. Search terms as following "Osteonecrosis of the femoral head" "treatment", "management". Conclusion ANFH is a progressing, multifactorial, and disabling disease generally seen in younger adults. After collapse of the femoral head and early osteoarthritis of the hip joint, arthroplasty could be a suitable treatment alternative if nonoperative and joint-sparing treatments fail. Basic science research study that can be used in clinical management has advanced rapidly, and these developments provide great promise for the future treatment of osteonecrosis of the hip. Clearly, ANFH is a difficult condition to manage, but with continuous growths in basic science and medical investigation, much more efficient treatment alternatives need to become available in the future.

Introduction:

Osteonecrosis of the femoral head (ONFH) is a chronic illness that reveals a difficult pathogenesis [1].Spontaneous repair of ONFH is a slow, alternate, and time-dependent process that may only take place in small size lesions without concomitant joint fluid seepage [2].Naw et alia's [3] clinical report exposed that 94% of asymptomatic ONFH will develop to symptomatic ONFH within 5 years. Untreated ONFH is believed to lug a poor result and typically leads to the incident of subchondral collapse within a short duration [3].Different surgical procedures are handy to eliminate pain and improve function of the affected femoral head in the onset, nevertheless, the secondary trauma triggered by surgical intervention continues to be an inevitable clinical problem and operations might not avoid deformity and collapse in degrading ONFH [4].Therefore, ways to turn around the early stage of ONFH and advertise reparative bone renovation becomes the secret for keeping the undestroyed joint beside sore areas and making available therapies to facilitate a great prognosis. Presently, the focus of surgeons and researchers is concentrated on: (1) enhancing the sensibility and accuracy of medical diagnosis to increase the rate of very early diagnosis; (2) improving surgery modern technology or establishing minimally invasive surgery to avoid the secondary injury caused by surgical intervention; and (3) exploring medicine or grafting items to promote reparative bone remodelling and acquire an excellent prognosis.

This article presents a review of ONFH classification systems, current treatment options, potential therapies, surgical and nonsurgical management and the relevant barriers affecting the treatment outcome.

Methodology:

MEDLINE, AMED, EMBASE, CINAHL, and the Cochrane Library were searched in details (for articles published up to November, 2017) for relevant articles in English language were included in the review. Search terms as following "Osteonecrosis of the femoral head" "treatment", "management". Reference lists of all retrieved articles were scanned for further relevant studies.

Discussion:

- **Factors affecting treatment outcome**

Radiological findings

The primary radiological findings which identify the treatment result are impairment of the femoral head and whether femoral head collapse and acetabular involvement has happened or not [5], [6], [7].The "crescent indication" observed prior to incident of femoral head collapse could indicate future mechanical failure. When hip joint surface involvement is less than 15%, this is

considered to be a great prognostic aspect and involvement over 30% is considered to be a poor prognostic factor [5], [6].

Femoral head collapse could have two bad prognostic features, the very first one of which is collapse of the femoral joint surface area of greater than 2 mm and the 2nd is the presence of a collapse field bigger than 30% of the complete femoral joint surface [5], [7].

In surgical therapy of ANFH, when making a decision whether the femoral head will certainly be protected or otherwise, acetabular involvement must be taken to account. Joint space preservation may also be discovered in cases with acetabular participation. Sparing of the femoral head may lead to therapy failure in such situations [5], [8].

Intraoperative factors

Along with preoperative examinations, intraoperative searchings for are also essential in selecting the appropriate therapy choice. Intraoperative arthroscopic examination of the hip joint is recommended to identify the condition of the joint cartilage material [5].When arthroscopy is not available, computed tomography scanning could be useful [5].

Patient-specific factors

Patient age, activity level, general health, and life span are elements influencing option of the most effective treatment method and its success. Range of motion in the hip joint, presence of discomfort, and limping ought to likewise be taken into account. Significant surgical interventions should be prevented in patients with systemic illness and a brief life expectancy. Therefore, similar lesions might be treated in various methods different patients. Definitive surgical intervention, eg, total hip arthroplasty, is preferred in patients whose general health could

not withstand a second treatment. Duration of preoperative signs and symptoms is another variable that determines the success of therapy [5].

- **Nonoperative treatment**

A meta-analysis in 1996 investigated the results of standard therapy for ANFH, and observed that in 819 patients complied with for 34 months without weight-bearing, more than 80% had an adverse result. As a result, the authors mentioned that the conventional approach has no place in the treatment of ANFH [5] Presently, traditional pharmacological and physical therapy approaches continue to be utilized regardless of these negative findings. The major pharmacological agents used for therapy of ANFH are antilipidemic agents, anticoagulants, vasodilators, bisphosphonates, anabolic steroids, and prostacyclin by-products [7], [8].Electromagnetic stimulation, [9] extracorporeal shock wave therapy, [10] and hyperbaric oxygen1 are the major physical approaches utilized in the conventional therapy of ANFH.

- **Operative treatment**

Conventional surgery for ANFH is split right into two groups, ie, femoral head-sparing and arthroplasty procedures. The femoral head-sparing technique is likely to have a good outcome if done before femoral head collapse takes place. On the other hand, arthroplasty is chosen in cases where collapse has taken place.

Femoral head-sparing strategies

Core decompression, integrated core decompression (with vascularized bone grafting and nonvascularized bone grafting), and rotational osteotomies are femoral headsparing approaches [8].Core decompression In 2000, Castro and Barrack analyzed the results of 22 studies including application of core decompression, including eight researches involving nonoperative treatment.

They concluded that the outcome of core decompression performed in the onset is dramatically much better compared to that of traditional treatment [5].

The efficiency of core decompression and its limited indications are controversial topics in the literary works [11].The option of strategy depends on the number of tunnels drilled and the diameter of the passages. Mont et al reported a patient collection followed up for 2 years, and 71% of 45 stage I hip instances treated with a 3.2 mm multiple opening treatment had favorable results [5].

In addition to core decompression, electrical stimulation, development factors, bone morphogenic protein, autologous bone marrow cell concentrate, and tantalum rod implantation have been utilized to boost efficacy. Vascularized or nonvascularized bone grafts have likewise been utilized in combination with core decompression. Electrical excitement has been reported to have a favorable impact in patients who were treated with core decompression [12].Mont et al reported favorable end results in 18 (86%) of 21 hips with allografts fertilized with bone morphogenic protein [13].In 2004, Liebermann et al used an autogenous fibular graft with 50 mg of bone morphogenic protein in his surgical collection of 17 hip cases (15 phase IIA, 1 stage IIB, 1 phase III). They reported that 93% of hips with stage IIA illness had favorable outcomes, which 3 with stage IIA, IIB, or III disease required complete hip substitute [14].In another study, the tunnel was loaded with either an autogenous iliac bone graft, an autogenous iliac bone graft ± demineralized bone matrix, or an allogenic bone graft after core decompression. Generally, favorable results were reported for 65% of instances [15].

Autologous concentrated bone marrow-derived mononuclear cell concentrate was first used in the therapy of osteonecrosis in the 1990s, and has been reported to have positive results. Performance of bone marrow cell transfer relies on the osteogenic result of the transplanted mononuclear cells

on the femoral head. This effect is the result of angiogenic cytokines being secreted by stromal bone marrow cells injected right into the femoral head and the taking place angiogenesis [16].Hernigou and Beaujean have released on the outcomes of core decompression and bone marrow cell injection in 189 situations. Only 9 of 145 patients with phase I or II condition needed overall hip replacement [17].Gangji et al made use of core decompression and bone marrow cell injection in 13 patients with phase I or II osteonecrosis of the femoral head, every one of whom remained pain-free and did not require overall hip replacement during a typical follow-up period of 2 years [18].In their research in 2011, Gangji et alia divided 24 early-stage hip situations right into two groups and utilized either core decompression or core decompression ± bone marrow cell injection. These patients were followed up for 5 years. While 8 of 11 hips in the control team proceeded to the fracture phase, just three of 13 revealed development in the bone marrow team[19]. Karatoprak et al made use of CD34+ cell concentrate, recognized to be both vasculogenic and osteogenic, in 9 phase I or II hip cases adhering to core decompression, and over a follow-up duration of 27 months, there was no development and no need for further surgical treatment in any one of the instances [20].

Nonvascularized bone grafting

Nonvascularized bone grafting can be utilized to support subchondral bone and joint cartilage by removing necrotic bone tissue and replacing it with a cortical or cancellous bone graft. 3 various nonvascularized grafting methods have ended up being popular with time. Utilizing the Phemister method, grafting is done with a core decompression system. The 2nd method includes grafting done via a window or a trapdoor in the femoral head. The 3rd method is grafting via a developed at the femoral neck or femoral head-neck joint [21].

In the literature, core decompression and nonvascularized grafting were used in 20 stage I or II hip cases. Tibial autografting, fibular autografting, and fibular allografting were used, specifically, in three, seven, and 10 hips. Instances were followed up for a minimum of 2 years, and positive results were acquired in 17 patients. In 17 hips, the graft was placed within the lesion and adjacent to the subchondral bone. In the continuing to be 3 hips, grafts were put right into the sore to the degree of the transitional zone between the infarct and regular bone. After carrying out core decompression in 85 hips with ANFH in a study in 2005, Keizer et alia used cortical tibial autografts and fibular allografts, respectively, in 18 and 62 patients, respectively. In their medical series of 47 phase II instances, they reported 44% revisions and 54% unfavorable results after a typical follow-up period of 4 years, and after 6 years, survival rates were 75% and 49% in patients with tibial autografting and fibular allografting, respectively. The writers wrapped up that grafting placement had no result on the end result of surgery; nonetheless, cortical tibial autografting given far better outcomes because of the osteogenic result [22].In 2008, a group of detectives reported that using cancellous chips sustained with bone morphogenetic protein-7 throughout nonvascularized grafting via a trapdoor strategy prevented the requirement for secondary surgical intervention in 80% of stage II and III hip cases [22].

Vascularized bone grafting

Following the removal of necrotic bone tissue from the femoral head, the contralateral fibula with its nutrient vessels is introduced with the head and neck of the femur, and the vessels are anastomosed microsurgically to the former circumflex artery and blood vessel [23].Judet and Gilbert reported in 2001 that fibular grafting in phase II and III patients under 40 years old produced positive lead to 80% of cases over a follow-up duration of 18 years. Nevertheless, they underlined that vascularized fibular grafting is not a great choice in sophisticated cases.26 In an

additional study, vascularized fibular grafting was utilized in stage II and III instances with an ordinary follow-up of 13.9 years, with negative outcomes and reverse overall hip arthroplasty needed in 10.5% of instances [23].Tetik et alia compared the results of vascularized and nonvascularized fibular grafting and found no substantial radiological difference in outcome between the two treatments. Nevertheless, the vascularized team had scientifically premium results. Favorable results have likewise been reported using vascularized pedicle iliac bone grafting integrated with transtrochanteric former rotational osteotomy in young people with innovative ANFH [24].

In 2010, Zhao et al reported the results of en bloc vascularized trochanteric grafting in 195 hip instances. The technique included translocation of a 3 centimeters long and 2 centimeters vast graft from the anterolateral trochanter together with the transverse branch of the lateral femoral circumflex artery to the necrotic region gathered from the femoral head-neck junction in stage II-IV situations. Postoperative digital subtraction angiography executed in 46 patients showed perfusion in the graft and the femoral head in 42 cases. After an average follow-up of 8 years, complete hip arthroplasty was not needed in 172 patients, whereas 23 patients needed conversion to total hip arthroplasty [25].

Osteotomy

Transtrochanteric rotational osteotomy was developed by Sugioka and Yamamoto in 1978. This procedure involves shifting an undamaged location to a weight-bearing portion of the joint, therefore leading to transfer of a lethal location to a non-weight-bearing portion. The scientific and radiographic prognoses after a transtrochanteric rotational osteotomy depend mostly on the ratio of the transposed intact location to the acetabular weight-bearing part after osteotomy. The intact area shifted need to be more than 36% of the weight-bearing area [26].

In their surgical series of 70 patients, Yamamoto et al utilized former rotational osteotomy in 57 hips with ANFH and done rotational osteotomy in 13 hips. At the end of a 10-year follow-up duration, necrotic fields had actually recovered with osteosclerosis in 71% of instances, and the continuing to be instances healed with typical bone tissue. None showed progression.

In their paper released in 2008, Sugioka and Yamamoto stated that they do posterior transtrochanteric osteotomy when the lethal area is located in the mid and posterior areas of the femoral head. In their research following 46 stage II and III hips for a mean of 12 years, they reported a mean 52-point enhancement in Harris hip score. Development was not radiologically observed in 65% of cases, while osteoarthritic modifications were located in 28%, but complete hip arthroplasty was not needed [26].

Intertrochanteric varus wedge osteotomy, generally utilized in osteoarthritis, was adapted for ANFH and made use of in 47 patients by Ito et alia, who reported favorable results for Harris hip score in 74% of instances and joint space narrowing and osteoarthritic changes in 26% of instances during a typical follow-up period of 18.1 years. Just 6 of their patients called for total hip substitute or hemiarthroplasty. The ordinary shortening was 19 mm, and the writers wrapped up that reducing is a trouble, so rounded varus osteotomy may be liked [27].On the other hand, Zhao et alia reported a success rate of 83.5%, after a mean 12.3 years of follow-up in their case series of curved varus osteotomy [28].Excellent end results were additionally reported in a research study where transtrochanteric rotational osteotomy and varization were made use of concurrently in broad lesions [29].

Conclusion:

Conclusion ANFH is a progressing, multifactorial, and disabling disease generally seen in younger adults. After collapse of the femoral head and early osteoarthritis of the hip joint, arthroplasty could be a suitable treatment alternative if nonoperative and joint-sparing treatments fail. Basic science research study that can be used in clinical management has advanced rapidly, and these developments provide great promise for the future treatment of osteonecrosis of the hip. Clearly, ANFH is a difficult condition to manage, but with continuous growths in basic science and medical investigation, much more efficient treatment alternatives need to become available in the future.

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