

Long-term Results after Treatment of Humeral Neck Fractures using Modified Hackethal Bundle Nailing

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ABSTRACT

Objective: This study reports the long-term surgical outcomes of elderly patients who underwent surgery using the modified Hackethal bundle nailing method on the basis of an approximately 10-year follow-up study.

Methods: We treated 34 patients (7 males, 27 females) with 2- and 3-fragment fractures of the proximal humeral neck. Their ages at the time of operation ranged from 65 to 75 years (mean age, 69.5 years). They were classified as Neer group I (G-I, 8.8%), III (G-III, 79.4%) or IV (G-IV, 11.8%). The duration of follow-up in patients averaged 130.6 months (range: 125.0 – 156.0 months). Patients were graded according to the Constant-Murley (CM) scoring system. Pre-operative and postoperative X-rays were also assessed.

Results: All the fractures united within 6 – 9 weeks, with an average of 7.4 weeks. The mean overall Constant score was 80.0 points (G-I: 83.3; G-III: 80.5; G-IV: 75.6). Among the 34 patients, 30 (88.2%) obtained excellent results and 4 (11.8%) obtained good results. Mal-union in the coronal plane was observed in two patients (6.28%) who had 160 degrees angulation in three part fracture. Mal-union of the greater tuberosity occurred in one patient (3.14%) leading to limitation of abduction to 90 degrees. There were no cases of avascular necrosis, neurovascular complications or deep infections.

Conclusion: This study suggests that the modified H-technique is simple, less invasive, and a reliable and effective procedure for elderly patients.

Keywords: Elderly patients, humeral neck fractures, long-term results, modified Hackethal bundle nailing.

Resultados a Largo Plazo del Tratamiento de Fracturas del Cuello Humeral Usando el Enclavado en haz de Hacketal Modificado

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RESUMEN

Objetivo: Este estudio reporta resultados quirúrgicos a largo plazo de pacientes de edad sometidos a cirugías mediante el método de enclavado en haz de Hacketal modificado, sobre la base de un estudio de seguimiento de aproximadamente 10 años.

Método: Se trataron 34 pacientes (7 varones, 27 hembras) con fracturas en dos y en tres fragmentos del húmero proximal. Sus edades al momento de la operación fluctuaban de 65 a 75 años (edad promedio, 69.5 años). Fueron clasificados como grupo I de Neer (G-I, 8.8%), III (G-III, 79.4%) o IV (G-IV, 11.8%). La duración del seguimiento en los pacientes promedió 130.6 meses (rango: 125.0–156.0 meses). Los pacientes fueron clasificados de acuerdo con el sistema de puntuación Constant-Murley (CM). También se evaluaron los rayos X preoperatorios y postoperatorios.

Resultados: Todas las fracturas cicatrizaron en un período de 6 – 9 semanas, para un promedio de 7.4 semanas. El promedio de la puntuación Constant general fue de 80.0 puntos (G-I: 83.3; G-III: 80.5; G-IV: 75.6). De los 34 pacientes, 30 (88.2%) obtuvieron resultados excelentes y 4 (11.8%) obtuvieron buenos resultados. Se observó una mala cicatrización en el plano frontal en el caso de dos pacientes (6.28%) que tenían 160 grados de angulación en una fractura en tres partes. La mala cicatrización de mayor tuberosidad ocurrió en un paciente (3.14%), y condujo a una limitación de la abducción de 90

grados. No se produjeron casos de necrosis avascular, complicaciones neurovasculares o infecciones profundas.

Conclusión: Este estudio indica que la técnica de Hacketal modificada es simple, menos invasiva, y constituye un procedimiento confiable y efectivo para los pacientes de mayor edad.

Palabras claves: Pacientes de edad, fracturas del cuello humeral, resultados a largo plazo

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INTRODUCTION

Generally, conservative treatment results in a satisfactory outcome in patients with humeral neck fracture. In patients where a reduction cannot be achieved because of a serious displacement of the bone or the reduced position cannot be maintained, use of open reduction techniques, such as percutaneous pinning (1), external fixation of the cortex with angled blade plate (2), using a wiring technique and intramedullary fixation (3) or percutaneous pinning using threaded pins (4), might be appropriate. Zifko and Poigenfurst reported a study of 48 patients with proximal humeral fractures who were treated by closed reduction, intramedullary fixation with elastic pins (5). Recently, Smejkal *et al* reported a case review of two- and three-part proximal humeral fractures treated using the Hackethal (Zifko) method (6). However, these earlier reports of results after proximal humeral fractures have often been short- or medium-term studies. In our practice, we modified the Hackethal bundle nailing method (7) that was first established as a surgical procedure for humeral shaft fractures in 1961. In this report, the clinical results and usefulness of this modified Hackethal (H)-technique based on an approximate 10-year follow-up study of 34 elderly patients who underwent surgery using this modified technique are discussed.

SUBJECTS AND METHODS

Thirty-four patients (7 males, 27 females) were treated with two- and three-fragment fractures of the proximal humeral neck. Their ages at the time of operation ranged from 65 to 75 years (mean age, 69.5 years). The Neer classification system includes four segments – I, II, III and IV – and also rates displacement and vascular isolation (8). According to Neer, a fracture is displaced when there is more than 1 cm of displacement and 45° of angulation of any one fragment with respect to the others. They were classified as Neer group I (G-I, 8.8%), III (G-III, 79.4%) or IV (G-IV, 11.8%). The duration of follow-up in patients averaged 130.6 months (range: 125.0 – 156.0 months). Clinical assessment was performed by doctors who did not participate in the primary surgery and patients were graded according to the Constant–Murley (CM) scoring system (9). Pre-operative and postoperative X-rays were also assessed. In the modified H-technique, the patient is placed in the prone position under general anaesthesia and the reduction is evaluated by bidirectional X-ray fluoroscopy (Fig. 1a). The simple instruments used in the modified H-technique include four or five ad-

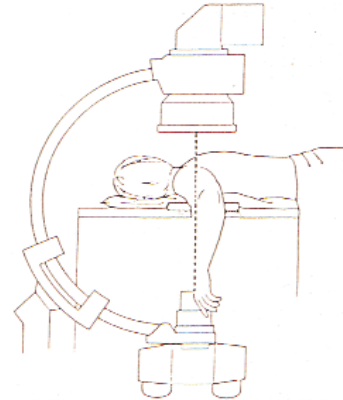


Fig. 1a: In the modified H-technique, the patient is placed in the prone position and the reduction is evaluated by bidirectional X-ray fluoroscopy during the traction and abduction of the shoulder joint. The forearm is placed in a position in which it hangs down from the operation table.

justed 2.4-mm Kirschner wires (K-wires) [Fig. 1b]. The extensor side of the upper arm is entered from the upper part of

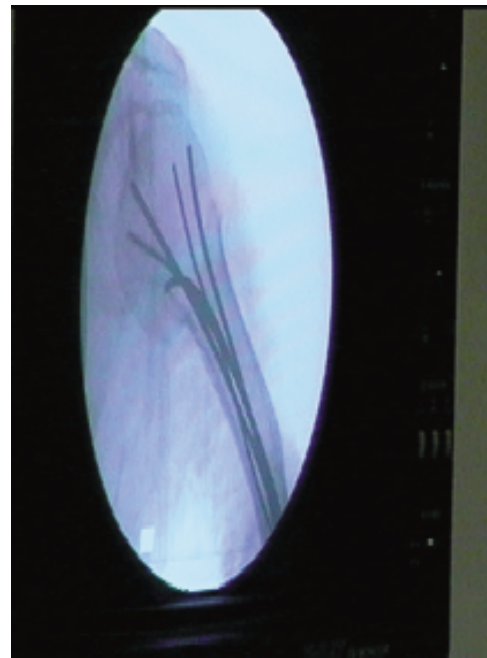


Fig. 1b: At least, 4 additional K-wires with curved tips are sequentially inserted so that the tips can be split in a fanwise manner in the humeral head.

the olecranon through a midline longitudinal incision, and the triceps muscle of the arm is bluntly divided on either side. The upper part of the olecranon fossa is subperiosteally exposed. At least four additional K-wires with curved tips are then sequentially inserted so that the tips can be split in a fan-wise manner in the humeral head (Fig. 2). For four fractures

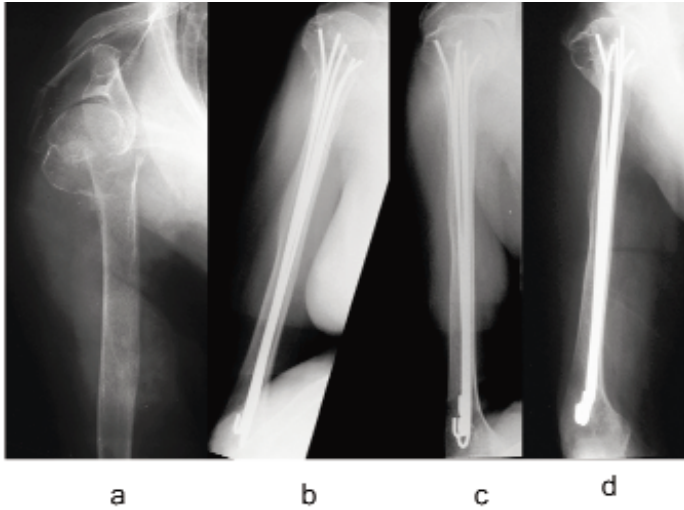


Fig. 2: (a) Preoperation, (b) after 1 day, (c) after one month, (d) after one year.

in the greater tuberosity of the humerus, cannulated screws were added.

RESULTS

All the fractures united within 6–9 weeks, with an average of 7.4 weeks. The mean overall Constant score was 80.0 points (G-I: 83.3; G-III: 80.5; G-IV: 75.6). Among the 34 patients, 30 (88.2%) obtained excellent results and 4 (11.8%) obtained good results. Mal-union in the coronal plane was observed in two patients (6.28%) who had 160 degrees angulation in a three part fracture. Mal-union of the greater tuberosity occurred in one patient (3.14%) leading to limitation of abduction to 90 degrees. There were no cases of avascular necrosis, neurovascular complications or deep infections.

DISCUSSION

The problems involved in treatment decisions include type of fracture, bone quality and the general condition of the patient. Several methods such as conservative treatment and variable forms of fixation have been proposed, but the long-term results have not always been satisfactory. Brunner *et al* evaluated the incidence of complications and the functional outcome one year after open reduction and internal fixation with a proximal humeral locking plate in 157 patients from 2002 to 2005. The incidence of implant-related complications was 9%; the incidence was 35% for non-implant-related complications. Primary screw perforation was the most frequent problem (14%), followed by secondary screw per-

foration (8%) and avascular necrosis (8%). After one year, the mean Constant score was 72 points; the mean Neer score was 76 points (10). Bahrs *et al* assessed the Constant score and radiographic outcome in 66 patients with minimally displaced and/or impacted fractures of the proximal humeral treated with early immobilization. All of the fractures healed well, without non-union. In 80% of patients, radiologic assessment showed fracture-displacement of less than 15° angulation and/or less than 5-mm displacement of the greater tuberosity. There was a significant association between the final Constant score and age (11). These reports of results after proximal humeral fractures are short- or medium-term studies, however, the present study discussed the clinical results and usefulness of our modified Hackethal (H)-technique based on an approximate 10-year follow-up study of 34 elderly patients who underwent surgery using this modified technique. The mean overall Constant score of our report was 80.0 points (G-I: 83.3; G-III: 80.5; G-IV: 75.6). Mal-union of the greater tuberosity occurred in one patient (3.14%) leading to limitation of abduction to 90 degrees. There were no cases of avascular necrosis, neurovascular complications or deep infections.

Hackethal bundled nailing is a surgical procedure developed by Karl Heinz Hackethal in 1961 (7). In the procedure, several 3.0-mm rods are inserted into a humeral shaft fracture from the upper part of the olecranon fossa. Although rods were used in the original technique, K-wires are used instead in our modified technique to allow the split tip to reach the subcortical cartilage. This treatment provides sufficient fixation that is required for the early introduction of rehabilitation measures.

In our technique, the J-shape formation of the peripheral end of the K-wire enables close fitting to the bone cortex, allowing successful prevention of postoperative pain with movement and extension disturbance of the elbow (12). Although the basic position is the prone position, the patient can be placed either in the supine or lateral decubitus position. Many cases of surgical treatment for this type of bone fracture have been reported. For example, Takeuchi *et al* reported on minimally invasive fixation for unstable two-part proximal humeral fractures using J-nails (1). Although this simple manipulation is regarded as an excellent procedure, the degree of fixation seems to be insufficient for preventing rotation in elderly patients who have a wide medullary cavity resulting from advanced osteoporosis. Descamps reported on biomechanical evaluation of Hackethal's intramedullary bundle pin fixation of humeral neck fractures using 30 frozen cadaveric humeri. In order to decrease the risk of pin migration, packing of the medullary cavity with as many pins as possible was recommended (13). In the case of the modified H-technique, the use of blocker nails as well as more than four K-wires assures the fixation of rotation to some degree. Depending on the space of the medullary cavity, blocker nails are added as per the requirement to prevent the detachment of the K-wires.

We will now explain indications and instructions by type of bone fracture. In cases classified as G-I, displacement is mild and conservative treatment results in a satisfactory outcome. Some of these patients might concomitantly suffer a fracture of the greater tuberosity of the humerus. In such cases, impingement resulting from displacement might be recognized during postoperative training even if plain X-rays reveal only minimal displacement. Therefore, the displacement of the greater tuberosity of the humerus should be examined cautiously, using multidirectional X-ray images along with a CT scan.

Surgical treatment is indicated in patients desiring an early return to their normal lives. The period during which the patient has a limited range of motion occasionally exceeds the standard period. In this case, a rotator cuff injury should be suspected and a routine arthro-MRI should be conducted to check for lesions. In cases classified as G-III, failure to maintain the reduced position is an indication for surgical treatment. Tight fixation is not necessarily essential in such cases. We have used the modified H-technique to treat 27 G-III patients, including patients with osteoporosis. We explained the detailed schedule of the postoperative rehabilitation to the patients with humeral neck fractures complicated by osteoporosis and started the programme relatively early. This therapeutic technique has been successful and no cases of re-displacement have been reported.

In cases classified as G-IV three-part fractures, the factors that determine the postoperative outcome are pain and limited abduction resulting from a serious displacement of the greater tuberosity of the humerus. But elderly patients who are less active and suffer slight displacements show relatively higher degrees of satisfaction as long as the pain is mild. Accordingly, tight extracortical fixation is not necessarily essential in these cases. Smejkal *et al* reported that the essential precondition of a good result is proper reduction (6). In this group, the modified H-technique is indicated in combination with the percutaneous auxilliary fixation of the greater tuberosity of the humerus with K-wire.

Although the modified Hackethal bundle nailing requires no complicated manipulation and assures the relatively early introduction of rehabilitation measures, the level of fixation needs to be improved. To achieve this, it is of prime importance and incumbent upon the treating surgeon to promote the patient's understanding regarding the necessity for rehabilitation and to provide appropriate guidance on post-operative training. Timing of the introduction of internal and external rotation movements should be carefully determined. The optimal indication for modified Hackethal bundle nailing is G-III two-part humeral neck

fractures. This technique can also be indicated for patients with G-I fractures who need an early return to their normal activity levels. If G-IV three-part fractures can be reversed to a state of minimal displacement by traction in the zero position, this technique, in combination with auxilliary fixation, can be indicated in such cases. Consequently, this technique is not indicated in patients who fail reduction.

In summary, the modified H-technique requires few complicated manipulations and assures the relatively early introduction of rehabilitation measures. This study suggests that the modified H-technique is simple, less invasive and is a reliable and effective procedure for elderly patients with humeral neck fractures.

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