بسم الله الرحمن الرحيم

∞∞∞

تم رفع هذه الرسالة بواسطة / حسام الدين محمد مغربي

بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى مسئولية عن محتوى هذه الرسالة.

ملاحظات : لا يوجد

Ain-shams University
Faculty of Medicine
Orthopedic Surgery

A Systematic Review of Methods of Fixation of Greater Trochanter Fracture During Hip Arthroplasty

Submitted in Partial Fulfillment for the Requirement of Master Degree
In Orthopedic Surgery

By
Islam Mohamed Ahmed Taalb

Bachelor of Medicine and surgery Cairo University

Supervisors

Prof. Dr. Osama Farag
Professor of Orthopedic Surgery
Faculty of Medicine - Ain-shams University

Dr. Ahmed Mehasseb
Lecturer of Orthopedic Surgery
Faculty of Medicine - Ain-shams University

Faculty of Medicine
Ain-shams University
2022

Acknowledgments

First of all, and above all, thanks to **ALLAH**, who gave me countless blessings. Without his blessings, this work would never be completed.

I would like to express my deepest gratitude and sincere appreciation to, **Prof Dr. Osama Farag,** Professor of Orthopedic Surgery - Faculty of Medicine - Ain-shams University for faithful supervision, guidance, continuous encouragement and stimulating interest throughout the course of research and useful comments during the writing of this study.

My deepest appreciation goes to **Dr. Ahmed Mehasseb,** Lecturer of Orthopedic Surgery, Faculty of Medicine - Ain-shams University for cooperation, encouragement and continuous support, kind advice. He kindly supervised me and reviewed all the details of the work.

I'd like to dedicate this work to my lovely family; without them I'm nothing.

Contents

Contents	Page
List of Tables	II
List of Figures	III
List of Abbreviations	IV
Introduction	1
Aim of the Work	3
Review of Literature	4
❖ **Anatomy**	4
❖ **Treatment objectives**	7
❖ **Cable system and cable plates systems**	7
❖ **Claw plates and Hook plates**	10
❖ **K-Wires and cerclage**	12
❖ **Trans-osseous sutures**	13
Patients and Methods	14
Statistical analysis and Results	18
Discussion	30
Summary	36
Conclusion	39
Recommendations	40
References	41
Arabic summary	١

List of tables

Table No.	Tables of results	Page
(1)	Study Characteristics	١8
(2)	Patient's characteristics	١9
(3)	Follow up period	١9
(4)	Side and Methods of fixation	20
(5)	Union and non-union	21
(6)	Harris hip score before and after treatment	21
(7)	Restored abduction function	22
(8)	Complication	23
(9)	Meta-analysis for Harris hip score	24
(10)	Meta-analysis for union	25
(11)	Meta-analysis for nonunion	26
(12)	Meta-analysis for complications	٢8

List of figures

Figure No.	Figures of review	Page
(1)	Illustration and photograph of lateral view of a right hip looking medially at the footprint insertions of the greater trochanter	4
(2)	Illustration and photograph of posterior view of right hemipelvis with muscles intact on the femur.	5
(3)	Cable system and Cable plates	8
(4)	Using cable plate system for greater trochanteric reattachment during hip arthroplasty	9
(5)	Preoperative radiograph for greater trochanter fracture and post operative fixation with cable plate	9
(6)	Trochanteric cable plate with oblique wires and good plate-bone apposition	9
(7)	3D view of the trochanteric claw plate fixing the Greater trochanter during hip arthroplasty	10
(8)	Anteroposterior radiograph showing a healed non-union of the greater trochanter in a 73 year old woman treated with claw plate	11
(9)	Diagrammatic representation of surgical technique for claw plate fixation of greater trochanter fracture during hip arthroplasty	11
(10)	Demonstration of hook plate applied for fixation of greater trochanter fracture during hip arthroplasty. (b) 3d picture to the trochanteric hook plate	12
(11)	Diagram of cerculage wiring technique for fixation of greater trochanter fracture during hip arthroplasty	12
(12)	(A) Preoperative anteroposterior radiograph showing an unstable intertrochanteric osteoporotic fracture; (B) 2 days postoperative radiograph demonstrating a hip replacement with satisfying reduction and rigid fixation of the great and lesser trochanters with Kirschner-wires and tension band; (C) 1-year postoperative radiograph demonstrating a bone union of the greater and lesser trochanters.	13

(13)	82 year old patient with AO classification type A2.2 intertrochanteric hip fracture had bipolar hemiarthroplasty with Ethibond suture of the greater trochanter fragments	13
(14)	PRISMA (preferred Reporting Items for Systematic Reviews and Meta-analysis) flow diagram for study selection	17
(15)	Forest plot for Harris hip score	٢4
(16)	Forest plot for union	٢6
(17)	Forest plot for nonunion	٢7
(18)	Forest plot for complications	٢9

List of Abbreviations

GT	Greater trochanter
THA	Total hip arthroplasty
HHS	Harris hip score

Abstract

The rigid fixation of greater trochanter has been supported by more and more surgeons, but the choice of fixation is still controversial. Traditional wires are widely used because of its relatively simple procedure and low cost. But the high failure rates also led orthopedists to seek for other more effective fixation methods.

In recent years, the appearance of locking plates has provided better stability for fracture fixation. These plates are widely used in various places of the human body, so some surgeons began to use locking plates to fix the greater trochanter fragment during hip arthroplasty surgeries. Compared with the conventional compressing plates, locking plates with uni-cortical screws can provide enough stability for fracture site.

The aim of study was to compare between methods of fixation of greater trochanter during hip arthroplasty according to type and postoperative outcome.

This review was on Non randomized and randomized controlled trials, prospective and retrospective studies which compare different methods of fixation of trochanter during hip arthroplasty. The search strategy identified 220 unique citations. Screening of titles and abstracts identified 90 potentially relevant articles. Full text review of these articles identified 10 studies meeting the inclusion criteria. 8 were retrospective and 2 prospective studies.

Keywords: Greater Trochanter Fracture, Hip Arthroplasty

Introduction

Fixation of the greater trochanter continues to offer one of the greatest challenges in total hip arthroplasty

In 1983, Dall and Miles [1] developed a new system for reattachment of the greater trochanter. The multi-braided metallic cables offered superior mechanical properties compared with traditional stainless steel monofilament wires allowing high compression loads [2].

However, the initial enthusiasm for these cables has declined considerably with the high complication rate published in several clinical studies [3].

The nonunion rates range from 20% to 31%, and cable breakage is seen in 10% to 19% with the existing systems [4]. One possible source of such a high failure rate is cable loosening and its effect on system integrity.

According to Haddad et al [5], initial cable relaxation in more than 50% of the studies and may limit their ability to maintain compression during the healing period. Furthermore, multifilament braided cable tends to fatigue and fray, leading to a multitude of new problems including release of metallic particulate debris into the body [6], accelerated polyethylene wear, and acetabular loosening [7]. In an attempt to restore abductor function more consistently than the cable system commercially available, locking plate technology were used

Although, Patel et al [8] reported favorable outcomes for the reattachment of trochanteric fragments using the third-generation cable

system in case of both complex primary THA and revision THA.

Although fixation device systems for reattachment have evolved considerably, a high rate of trochanteric fixation device failure, non-union, and bony migration have been reported

Aim of the work

The aim of this study is to compare between methods of fixation of greater trochanter during hip arthroplasty according to type and postoperative outcome. Four methods were used:

- Cable plates and cable system
- Claw plates or Hook plates
- Kirschner-wires and tension band
- Intra osseous sutures

Anatomy

a. The greater trochanter:

The greater trochanter is a site of attachment for multiple anatomic structures, most importantly, the abductors proximally, the vastus lateralis distally, and the short external rotators posteriorly [1]. Fig 1.

The gluteus medius insertional footprint is located on the lateral aspect of the greater trochanter; from the posterior tip of the greater trochanter to the antero-inferior corner of the lateral facet [9].

The gluteus minimus insertional footprint is located at the anterior facet of the greater trochanter; from the anterior tip of the greater trochanter to the antero-inferior vastus tubercle [10]. Fig 2.

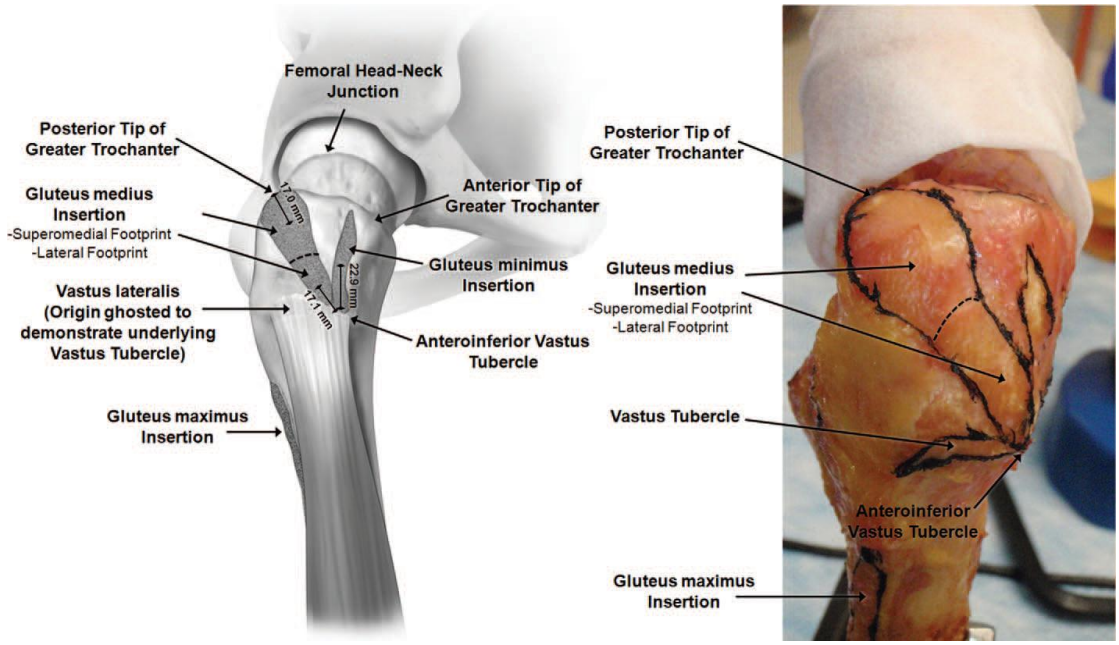

Fig. 1. (Left) Illustration and (right) photograph of lateral view of a right hip looking medially at the footprint insertions of the greater trochanter. The footprints of the gluteus medius, gluteus minimus, and vastus lateralis with respect to the vastus tubercle are depicted.

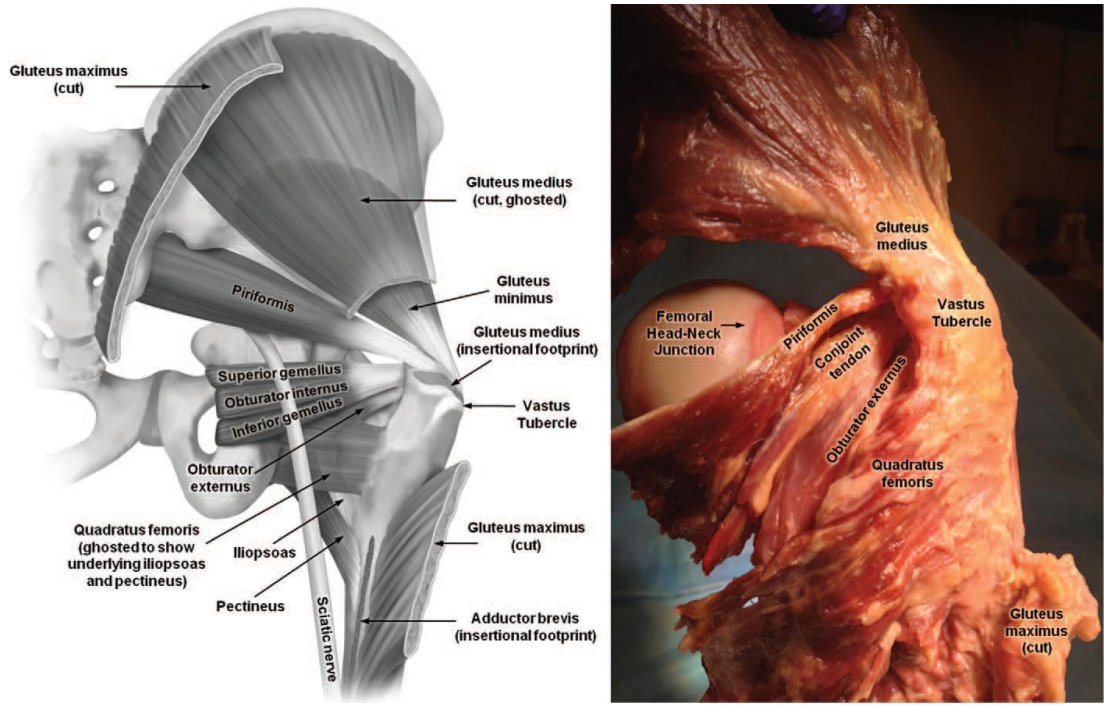

Fig. 2. (Left) Illustration and (right) photograph of posterior view of right hemipelvis with muscles intact on the femur.

b. **The Abduction mechanism:**

Hip abduction refers to the movement of the hip joint as the leg is moved away from the midline of the body.

As the hip is composed of a ball and socket joint, a degree of rotation is also present during this motion. A group of muscles contribute to hip abduction; the most important of these is the gluteus medius.

The primary hip abductor muscles include the gluteus medius, gluteus minimus, and tensor fasciae latae. the piriformis, sartorius, and superior fibers of the gluteus maximus are considered secondary hip abductors.

The hip abductor muscles stabilize the hip within the frontal plane during the single-limb support phase of walking. When a given limb enters mid stance, the opposite leg is in its swing phase—not in contact with the

ground. Activation of the stance leg's hip abductor muscles normally holds the pelvis level, allowing the swing leg to advance toward the next step. Without sufficient strength of the hip abductor muscles on the stance leg, the opposite side of the pelvis may drop excessively under the force of gravity. This abnormal response is known as a positive **Trendelenburg sign** and strongly suggests weakness of the hip abductor muscles.

With the pelvis held fixed, contraction of the hip abductor muscles abducts the femur away from the midline. This action typically places a relatively low demand on these muscles. A more demanding (and common) activity imposed on these muscles occurs during closed-chain activities such as when the femur is fixed to the ground while standing on one leg (so-called single-limb support). Verify on yourself that while standing only on your right leg, "hiking" the left side of your pelvis is accomplished by a relatively strong contraction of your right hip abductors. (These muscles can be palpated midway between the greater trochanter and the iliac crest) [11].

Treatment objectives

In the setting of a GT fracture, all these muscle attachments apply competing biomechanical forces on the GT fragment. These forces need to be neutralized at the time of fixation to achieve mechanical stability at the fracture site. Therefore, surgical stabilization of GT fractures can be quite challenging [12]. Functional disabilities secondary to GT nonunion has been mainly attributed to proximal migration of the GT fragment >1 cm, which can lead to abductor insufficiency [13].

Some GT nonunions have been characterized as stable fibrous unions that cause minimal functional limitations. Patients with GT nonunion can experience significant lateral hip pain, abductor lurch, Trendelenburg gait pattern, as well as component loosening and instability of their total hip arthroplasty [14]. To enhance the potential for GT union at the fracture site, surgical fixation should be strong enough to convert the shear and pulling forces on the GT fragment into compression forces. There are a variety of surgical techniques and implants described to reattach the GT [13].

Cable system and cable plates systems

Cables are often used to increase stabilization of fractures and osteotomies. Constant tension of the cables allows permanent compression of the bone fragments and fracture healing [15].

The cable-plate system is one of the implants commonly used to stabilize GT fractures which have undergone multiple evolutions in its design to