Systematic review of nerve injury following total hip replacement with posterior or lateral approach

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Abstract

Background: Total hip replacement, is common surgical procedure, performed through posterior or lateral approach but it is yet not clear which method is safe and provides reduced risk of nerve injury. Nerve injury after total hip replacement can be severely debilitating leading to poor outcomes. Thus we performed this systematic review with the aim to assess the risk of nerve injury after THR by different surgical approaches and to evaluate the adverse effects and the functional outcomes of nerve injury after THR

Material & Methods: A thorough literature search was conducted of Cochrane Bone Joint and Muscle Trauma Group, Cochrane Database of the Systematic Reviews, Cochrane Central Register of Control Trials, MEDILINE, EMBASE and CINAHL from their inception to 29 May 2014. Grey literature was located via the website www.opengrey.eu, conference proceedings and trial registries. Prospective and retrospective case series and case control studies were included in the systematic review. The inclusion criteria were adult population of 18 years and above with total hip replacement for osteoarthritis, dysplastic hip, acetabular fracture or revision total hip replacement. The exclusion criteria were patients below 18 years of age, with pre-operative nerve palsy or with previous medical conditions like stroke and low back pain. Cadaveric and biomechanical studies and studies conducted in non-English languages were excluded. Authors independently selected the studies using inclusion and exclusion criteria, assessed risk of bias and extracted the data.

Results: A case control study, two prospective case series and two retrospective case series were included in this systematic review. The studies selected overall reported 97 patients with nerve injury following 36735 total hip replacements (prevalence 0.2%). Only one out of the five selected studies reported, stated statistically significant effect of outcome of nerve injury after THR, following posterior approach compared to lateral approach.

Conclusion: The systematic review results revealed an overall very low quality of evidence and could not offer support for any particular surgical approach to reduce nerve injury during total hip replacement. The systematic review underlined the need for further studies to properly establish the risk factors associated with different surgical approaches to improve evidence based knowledge and reduce patient disability.

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Introduction

Total Hip Replacement (THR) is considered as a gold standard of treatment for hip arthritis, eliminating severe pain and maintaining mobility [1]. Nerve injury is a significant and debilitating complication after total hip replacement. In early studies the clinical incidence of nerve injury varied from 0.3% to 4% in primary THR [2,3]. However,

electromyographic (EMG) studies indicated the incidence of nerve injury in up to 70% of cases [4]. Thus prevalence of nerve injury reported by different studies previously are variable as the subclinical nerve damage occurs more often and only the severe form of nerve injury after THR presents clinically. The range of nerve injury varies from transient blocks in conduction to irreversible damage secondary to the mechanical disruption of axons and endoneural sheath [5].

Traditionally sciatic nerve injury is commonly associated with posterior approach for THR and the exact cause is unknown and many mechanisms have been described [6,7]. But other nerves can also be injured like femoral nerve, peroneal nerve, obturator nerve or superior gluteal nerve. Superior gluteal nerve injury after THR is associated with weakness of hip abductor mechanism but electromyographic (EMG) studies show that most of these injuries are subclinical [8]. The most common risk factor for injuring femoral nerve during THR is during placement of anterior acetabular retractor, whereas risk of obturator injury is when cement, screws or reamer penetrate the anterior quadrant of the acetabulum which is perceived as persistent pain in groin or thigh, hip adductor weakness, referred knee pain, visible cement or intra-pelvic screw [4,9-10].

Thus these variations in nerve injury following THR stimulated us to undertake this systematic review to assess nerve injury following THR in patients suffering from osteoarthritis, dysplastic hip, fracture of hip, osteonecrosis and in also revision THR and to determine the risk of nerve injury with different surgical approaches and to evaluate the adverse effects and functional outcomes after the nerve injury.

Material and Methods

Systematic review was done to assess the incidence of nerve injury after THR, its relation with surgical approach and functional outcome.

Human studies with THR done on patient with age more than 18 year for osteoarthritis, dysplastic hip, acetabular fracture or revision THR were included. Studies with THR on patients with preoperative nerve palsy and previous medical conditions like stroke and low back pain influencing the diagnosis of nerve injury after THR were excluded from the study. Cadaveric, biomechanical and studies in non-English language were also excluded.

A comprehensive electronic database literature search was conducted of Cochrane Bone Joint and Muscle Trauma Group, Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects (DARE), The Campbell Collaboration Library of Systematic Reviews, National Institute of Clinical Excellence (NICE), Scottish Intercollegiate Guidelines Network (SIGN), healthcare databases, trials, MEDLINE, EMBASE and CINAHL, for studies to be included. Current Controlled Trials (www.controlled-trails.com) and WHO International Clinical Trials Registry Platform (www.who.int/ictrp/en) were also searched to identify completed and ongoing clinical trials. All Empirical research studies were searched for existing literature about nerve injury following total hip replacement with posterior and lateral approach without any date limit. Specific empirical study designs were not searched.

Grey literature search was conducted on www.opengrey.eu (searched 25 May 2014). In addition, Google Scholar (www.scholar.google.com), websites for orthopaedics and professional societies, e.g British Hip Society, British Orthopaedics Association and American Academy of Orthopaedics Surgeons were also searched. Hand searching of key orthopaedic journals was conducted for 3 months (March 2014 to May 2014) to pick up studies which had not yet appeared in indexed databases. These journals are Journal of Bone and Joint Surgery (British and American), Journal of Arthroplasty, Hip International, Clinical Orthopaedics and British Medical Journal.

The advance literature searches was done for truncated key words with asterisk (*) to include all variant endings. The MeSH terms were combined with Boolean logic using the operators AND, OR. Where OR was used to combine related terms, AND was used to combine all the components of PICOS (Higgins & Green, 2011). Keywords searched words or

search were Total Hip Replacement*, Posterior*, Lateral*, Hardinge*, Nerve Injury* and Peripheral Nerve Injury*.

After the comprehensive literature search all the long-listed articles were catalogued and relevant search results were screened and were grouped into the following categories, namely 'accept', 'reject' or 'not sure', by consensus of two reviewers, depending on the inclusion and exclusion criteria. Accepted article were included whereas rejected articles were excluded and the articles in the 'not sure' group were sent to a third independent reviewer, specialized in hip surgery for comment, further planning and for acceptance or rejection.

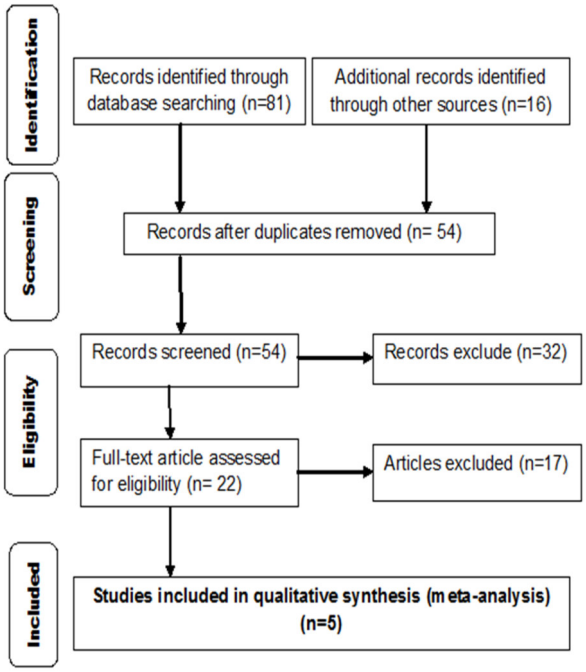
The data from the accepted study was extracted by two independent reviewers using a pre-developed and tested data extraction form describing the study design following 'PICOS' – population characteristics, intervention data, comparison, outcome and study design characteristics. The third independent reviewer was consulted for any disagreement for the final decision. Data extracted from these studies were collected considering ethical approach.

Results

The search resulted in identification of 81 potentially eligible studies from the electronic databases. An additional 16 articles were identified through citation tracking. Searches of clinical trial databases did not identify any on-going trials. A total of 54 titles and abstracts were reviewed and 22 articles were selected for full text assessment after excluding the remaining 32 articles on reading the abstract (fig 1). After applying the inclusion and exclusion criteria only 5 studies with sample size of 36735 total hip replacements (THR) were included in this systematic review (table 1) [11-15].

We were unable to interpret average and range of patient age as not all the included studies in the systematic review described the patient characteristics in detail. Osteoarthritis (46%) was the single most common underlying indication for THR in patients who were subsequently diagnosed with nerve injury post-operatively. Other indications were developmental hip dysplasia (19%), post-traumatic arthritis (10%), rheumatoid arthritis (10.6%), osteonecrosis (6%) and post infection arthritis (2%).

Fig 1. Flowchart showing how the studies were included



All the studies assessed risk factors of nerve injury following THR. Hurd et al had compared the post-operative sciatic nerve injury after THR with standard posterior approach to posterior approach with routine gluteal maximus release assessing nerve injury clinically as well as by electromyogram (EMG) and Magnetic Resonance Imaging (MRI) of hip to record the compressions of nerve [12]. Farrell et al and Weale et al had studied the risk factors and prognosis of motor nerve injury after primary total hip replacement by clinical examination and electrophysiological study [11,14]. Farrell also recorded the time of recognition of nerve injury, severity of the nerve injury (complete or incomplete), clinical presentation of the injury and the anatomical distribution such as sciatic or peroneal component of the nerve involved and possible etiology of nerve injury and also assessed functional status, anatomical distribution and possible etiology of nerve injury after THR [14]. Navarro et al and Nercessian et al had compared the incidence of nerve injury in posterior and lateral approach for primary as well as revision THR with nerve assessment clinically and EMG [13,15]. Navarro et al also assessed the sciatic nerve tension by palpation

of nerve intra-operatively, whereas Nercessian et al also reported nerve injuries in upper limb caused due to traction or compression during positioning of patients although we excluded these injuries as they did not contribute to our review [13,15].

Inconsistencies were observed in reporting nerve injuries among the different approaches. In total of 36735 THR, 97 patients sustained nerve injury (prevalence 0.2%). Incidence of nerve injury in lateral approach including transtrochanteric approach was 0.16% (62 patients), where in rest 35 out of 36735 THR (prevalence 0.09%) is via posterior approach. As per Hurd et al 3 out of 804 patients (0.3 %) had sciatic nerve injury in control group i.e. with routine posterior approach whereas no patient had nerve injury in gluteal maximus tendon release group [12]. Study by Farrell et al reported posterior approach had higher risk of nerve injury compared to anteriolateral approach (p value=0.032), while other studies were unable to report any significant difference in incidence of nerve injury between the two approaches [11-15].

Only two studies Hurd et al and Farrell et al reported recovery in post-operative period which was 33 to 36%, with Farrell et al mentioned 14 patients (36%) recovered completely to preoperative level, 10 patients (24%) had partial recovery and 17 patients (41%) had no recovery in average time of 21 months, whereas Hurd et al described that only 1 patient (33%) regained full strength in affected muscles [11,14].

Discussion

Nerve injury is a significant and debilitating complication after THR. The nerve injury varies from just neuropraxia with transient conduction block to severe irreversible damage due to the mechanical disruption [5]. The incidence of nerve injury after THR ranges from 0.3 % to even 70%, when subclinical cases are also included [1-3]. Traditionally sciatic nerve injury is commonly associated with posterior approach is the mostly injured nerve [4,5].

Due to variations in nerve injury following THR, we performed this systematic review to assess nerve injury following THR and its relation to the approach. To make the results critical and reproducible, careful selection of articles was done. Cadaveric, biomechanical and non-english studies were excluded as they do not simulate the operating conditions and other languages are beyond the scope of this systematic review. Randomised control trials were not present as evident by the literature searches as it is difficult to conduct due to ethical reasons, analysing the adverse effects of two surgical approaches of total hip replacement.

After literature search five studies were selected, one was case control study (Hurd et al 2006), two prospective case series (Weale et al 1996, Navarro et al 1995) and two retrospective case series (Farrell et al 2005, Nercessian et al 1994) which analysed 36735 THR in 36593 patients [11-15]. 97 (0.2%) patients had nerve injury after THR and incidence of nerve injury in lateral approach including transtrochanteric approach was 0.16% (62 patients), and in posterior approach was 0.09% (35 patients).

All were single centre studies, with one conducted in the UK (Weale et al 1996) and other four conducted in USA (Hurd et al 2006, Farrell et al 2005, 1996, Navarro et al 1995 and Nercessian et al 1994). All the studies were conducted in teaching hospitals conducted between 1994 and 2005, but as the studies included retrospective as well as prospective data the period THR ranged from 1970 to 2004 [11-15].

Weale et al (1995) concluded that nerve injury after THR is underestimated, as only clinical diagnosis is made instead of clinical as well as electrophysiologically by electromyography (EMG) examination. Hence the incidence of nerve injury reported by Weale was high to be 20% after THR in direct lateral approach, but none with posterior approach when they used both clinical and electrophysiological evidence for diagnosis [11]. According to them the increased nerve injury in lateral approach is because posterior approach is more anatomical than direct lateral approach which requires less traction during operation hence reducing the chance of nerve injury.

Table 1: Study characteristics **[11-15]**

Author year Country	Method	Inclusion Criteria	Exclusion Criteria	Patient Characteristics	Surgical Intervention	Assessment of Nerve Injury	Outcomes
Hurd et al (2006) USA	Case control study	Primary total hip arthroplasty (THR)	None mentioned	308 male patients and 383 female patients.752 Total hip arthroplasty in 691 patients (bilateral hip replacements in some patients) with gluteal maximus tendon release with posterior lateral approach (Group A). Control group consisted of 804 hip replacements for 723 patients (Group B).	Group A: THR with Posteriolateral approach with gluteal maximus tendon release (N=752) Group B: THR with posteriolateral approach (N=804)	Clinical Examination, Magnetic resonance imaging (MRI) scan Electromyography (EMG)	Group A: No nerve injury Group B:3 patients sustained sciatic nerve injury
Farrell et al (2005) USA	Retrospective case series	Primary total hip arthroplasty (THR)	None mentioned	18 male patients and 29 female patients identified with nerve injury after primary total hip arthroplasty. 1 patient lost in follow up. Mean age=57 (Range 20 yrs-89 yrs) 27,004 Primary THR performed between 1970 and 2000 Patient distributions in each group were not defined.	Group A: Anteriolateral approach (N=not mentioned) Group B: Transtrochenteric approach* (N= not mentioned) Group C: Posterior approach (N= not mentioned) *Transtrochanteric approach is a variant of lateral approach.	Clinical Examination and Electromyography (EMG)	Group A: 22 patients sustained nerve injuries Group B: 9 patients sustained nerve injuries Group C:16 patients sustained nerve injuries
Weale et al (1996) UK	Prospective case series	Primary total hip arthroplasty	Neurological disease, sciatica	Group A: Posterior approach group (n=22) Group B: Direct lateral approach group (n=20)	Group A: Primary THR with Posterior approach Group B: Primary THR with Lateral approach	Group A: Preoperative and Postoperative EMG Group B: Preoperative and Postoperative EMG	Group A: No nerve injury Group B: 4 patients sustained nerve injuries, 1 of them sustained two injuries

							2 obturator nerve injuries, 1 femoral, 1 posterior tibial and 1 common peroneal nerve injury
Navarro et al (1995) UK	Prospective Case Series	Primary Total Hip arthroplasty, Revision Total hip arthroplasty	None mentioned	1000 patients with 472 male and 528 female patients	Group A: Direct Lateral approach Primary=282/630 Revision=178/370 Group B: Posterior Approach Primary=348/630 Revision=192/370	Clinical examination	Group A: 5 sciatic nerve palsy Group B:1 femoral and 2 sciatic nerve palsy
Nercessian et al (1994) USA	Retrospective Case series	Total Hip arthroplasty	Neurological disorders, Stroke	42 patients with nerve injuries included 12 males and 30 females with average age of 58 yrs (range 27-81 years). Primary diagnosis were osteoarthritis in 20 patients, inflammatory arthritis in 15, congenital dislocation of hip in 5 and miscellaneous pathologies in 2. Out of 7133 consecutive patients who underwent THR, 42 subsequently sustained nerve injury and the study analysed the risk factors for the different surgical approaches.	Group A: Primary THR with transtrochanteric approach Group B: Primary THR with posteriolateral approach Group C: Revision THR with transtrochanteric approach	Clinical examination Nerve conduction test	Group A: 9 peroneal nerve palsy Group B: 13 nerve injuries (4 sciatic, 7 peroneal, 1 lateral femoral cutaneous and 1 femoral nerve injury) Group C*: 12 nerve injuries (8 peroneal nerve injury, 1 sciatic, 1 femoral and 1 obturator nerve injury) *some upper limb nerve injury were reported in post THR patients

Farrell et al (2005) reported that the risk of nerve injury is significantly higher in posterior approach compared to lateral approach (p=0.032) [14], whereas Nercessian et al (1994) reported more incidence of nerve injury in trans-trochanteric or lateral approach (21 patients out of 34) [14,15]. Navarro et al (1995) conceded that in both primary and revision total hip replacement there is no statistical difference between approaches for the risk of nerve injury, rather it is anatomical variation and complexity of the hip reconstruction that is associated with the risk of nerve injury [13]. Hurd et al 2006 and Farrell et at 2005 both the studies reported recovery after nerve injury in 33% to 36% cases to preoperative level muscle power which took an average of 21.1 months [12,14].

Despite the many potential causes of sciatic nerve palsy listed in literature, large reviews show that in about 50% of cases, the cause is unknown. Hurd et al (2006) proposed the unexplained sciatic nerve palsy after THR is due to transient compression between ischial tuberosity and femoral insertion of gluteal maximus or stretch during operation. Subclinical intraoperative sciatic nerve palsy is due to positioning of leg in relation to hip joint in flexion, adduction, internal or external rotations during femoral preparation. They further concluded that release of gluteus maximus tendon during posterior approach and correct positioning of the limb with hip in extension and abduction will reduce the chance of nerve injury. Similar findings are seen by Stone et al [16].

Jolles et al also performed similar systematic review evaluating the risk of complications after THR, but only on osteoarthritis patients. Since we include other patients also in our study, hence our study overcomes the limitations of the previous systematic review and improves the quality of evidence [17].

Our study is limited by not assessing medico-legal aspects and disability claims following nerve injuries. Further studies are required to assess the cost impact of disability following nerve injury, chances of recovery after nerve injury and disability prior to total hip replacement. The strength of this systematic review is a comprehensive database search along with additional grey literature search, identifying all the existing published studies applying advanced search techniques without date and design limitation. Our systematic review could be used as the basis of explaining the chance of nerve injury during THR while taking consent from patients and could be also used for further studies to find correlation between surgical approaches and nerve injury.

Conclusion

Our systematic review results revealed an overall very low quality of evidence and provided insufficient support for either posterior approach or lateral approach for total hip replacement to avoid nerve injury. There is no substantial evidence to argue for a change of current practice in preference for a particular surgical approach for total hip replacement to reduce risk of nerve injury. Hence the choice must be based on individual patient and surgeon's experience. Further research is required to establish the risk factors of nerve injury associated with different surgical approaches for total hip replacement.

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