ORIGINAL ARTICLE

The long-term outcomes following internal fixation for intracapsular hip fractures in an Irish tertiary referral centre

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Abstract

Background The burden associated with hip fractures is increasing worldwide. Arthroplasty procedures are more commonly performed for intracapsular fractures due to increased risk of compromise to the femoral head blood supply. However, we know from the Irish Hip Fracture Database that a significant proportion of these fractures undergo internal fixation.

Aims We sought to investigate the long-term outcomes for these patients including revision rates, functional outcome and mortality rates.

Methods All intracapsular fractures treated by internal fixation (IF) from 2005 to 2009 were identified. Pre-operative anatomical fracture location and level of fracture displacement was established. Hospital records were used to record mortality and revision rates. The modified Harris hip score was our primary functional outcome measure.

Result One hundred twelve intracapsular fractures underwent IF over a 5-year period. The mean age was 68.6 (range 14–95 years). A mean follow-up time of 8.15 years (range 6.7–10.1 years) was achieved. There was a 5-year mortality rate of 36.6%. There was a significantly higher revision rate in displaced fractures (24.4%) than in undisplaced fractures (11.1%) ($p = 0.01$). We found no difference in functional outcome between displaced fractures [85.9 (± 16.9)] and undisplaced fractures [86.01 (± 18.8)]. Those aged younger than 65 at the time of surgery had a significantly better MHHS ($p = 0.02$) at long-term follow-up; however, there was a revision rate of 43.8% in this group.

Conclusion Whilst a good functional outcome can be achieved with internal fixation, particularly in younger patients, the risk of requiring revision surgery approaches 50% for these patients.

Keywords Functional outcome · Hip fractures · Mortality · Revision surgery

Introduction

Hip fractures are a common injury associated with significant morbidity, mortality and cost [1]. In Ireland, the number of hospitalisations for hip fractures is projected to increase by almost 90% in the coming decade in line with our ageing population [2, 3].

Hip fractures are divided based on anatomical location into intracapsular and extra-capsular, with 52% classified as intracapsular based on the Irish Hip Fracture Database (IHFD) annual report [4]. Internal fixation is considered the reference standard for the management of both extra-capsular and undisplaced intracapsular neck of femur fractures. However, 80% of intracapsular fractures admitted to hospital are displaced [4], and the management of these fractures has been a controversial topic for many years.

Anatomical studies tell us that displaced intracapsular fractures are at increased risk of damaging the blood supply to the femoral head, lending support to the use of arthroplasty for treating these fractures. Meta-analyses have shown that arthroplasty is associated with lower complication and reoperation rates when compared with internal fixation for displaced fractures [5]. NICE guidelines also recommend total hip arthroplasty (THA) as an option for the more active younger patient with displaced intracapsular fractures. In line with this evidence, the vast majority of displaced intracapsular fractures in Ireland and the UK are now treated using arthroplasty procedures [3]. However, in order to preserve the native joint in active patients or undertake a lower risk procedure in very elderly patients, 6% of displaced intracapsular fractures are treated with internal fixation [4].

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There is very little published data available on the functional outcomes following internal fixation of these fractures [6]. Where evidence does exist, it is in the follow-up of randomised controlled trials comparing arthroplasty and internal fixation in elderly patient populations.

We sought to investigate the long-term outcomes following internal fixation of intracapsular fractures in our institution. We aimed to directly compare functional outcomes as well as the revision and mortality rate in displaced and undisplaced fractures across different patient age cohorts.

Methods

A retrospective study was designed and the hospital ethics committee granted ethical approval. Theatre logbooks between January 2005 and December 2009 were reviewed. Operative records for all surgeons working in a tertiary referral hospital were analysed. All hip fractures treated by internal fixation were identified. Pre-operative and intra-operative radiographs were reviewed. All intracapsular neck of femur fractures (NOFFs) were selected for inclusion in our study and a database was established which included patient demographic information, side of operation and type of fixation procedure performed.

The level of fracture displacement was recorded using the Garden classification. This classification system divides intracapsular fractures sequentially into undisplaced fractures (Gardens 1 and 2) and displaced fractures (Gardens 3 and 4). Garden 1 fractures are partial fractures whereas Garden 2 fractures are complete neck of femur fractures which are undisplaced. Garden 3 fractures are partially displaced, with Garden 4 fractures being completely displaced.

Fractures were also classified according to their anatomical location. Where pre-operative imaging was not available, written hospital records or intra-operative screening was used to record anatomical fracture location.

The electronic patient demographic system (PAS system) was used to identify deceased patients. Time of death was recorded for analysis and those who had passed away less than 5 years after their hip fracture were recorded as an outcome group also.

The Impax and NIMIS image viewing systems were used to assess patients' most up to date imaging. Those who had 5-year radiological follow-up were recorded as an outcome group for analysis. Radiological evidence of revision surgery was also recorded.

All remaining patients available for follow-up were contacted to assess their functional outcome. Patients were contacted by telephone and consented for inclusion in the study. Patients were also contacted by post and by telephone calls to next of kin in order to complete follow-up in the largest possible number of patients.

In patients identified through phone follow-up having had revision surgery confirmation of revision surgery was sought through medical notes, imaging review, or correspondence with the treating surgeon. A chart review of all patients in the RIP group was performed to assess for evidence of revision surgery prior to death. For all revision surgeries, time to revision and type of surgery performed was recorded.

The modified Harris hip score (MHHS) was used as the primary assessment tool. This is a modified version of the well-established Harris hip score, which assesses patients across 8 areas of function and pain. A maximum score of 100 is generated indicating excellent hip function. Outcome data was collected at a minimum of 5-year follow-up and time to follow up was recorded also.

Our data was analysed where appropriate using SPSS version 22. Age, gender and time to follow up were also included as independent variables. Statistical significance was assumed at $p < 0.05$.

Results

Demographic data

A total of 518 hip fractures were treated by internal fixation during the study period. Radiographic review identified 112 of those as intracapsular fractures. There were 108 sliding hip screws and 4 cancellous screw fixations. The mean patient age was 68.6 years (range 14–95 years). The mean duration of follow-up was 8.15 years (range 6.7–10.1 years). The 4 patients treated using cancellous hip screws ranged in age from 14 to 56 with three Garden 2 fractures and a Garden 3 fracture in one 56-year-old patient.

Fracture configuration

Pre-operative radiographs were available for 86 patients (76.8%) with displaced fractures accounting for 47.7% ($n = 41$). Fracture number by Garden classification is shown in Table 1, with Garden 2 and 3 fractures accounting for 86% of classified fractures.

Table 1 Overall fracture, mortality and revision figures by Garden classification

Level of displacement	Number ($n = 112$)	RIP	Revision
Garden 1	6	2	1
Garden 2	39	14	4
Garden 3	35	17	8
Garden 4	6	4	2
Not classified	26 (23%)	16	2
Total	112	53 (47%)	17 (15.2%)

Both age groups had an equal distribution between displaced and undisplaced fractures, with 47% having displaced fractures in the 65 or over group and 48% having displaced fractures in the < 65 group.

Sixty-five percent ($n = 73$) of patients included in our study were aged 65 or over and 35% ($n = 39$) were less than 65.

Fractures were also classified according to their anatomical location. Transcervical fractures accounted for 43% of fractures, with 27% of fractures basicervical and 30% subcapital (Table 2).

Mortality

The overall mortality rate during the follow-up period was 47.3% ($n = 53$). There was a 5-year mortality rate of 36.6% ($n = 41$). The mean time to death was 2.89 years (range 16 days to 9.5 years) at a mean age of 75.9 years (range 30–93 years). Patients less than 65 had a mortality rate of 20.5% during follow-up compared with a mortality rate of 61.7% in patients aged 65 and over during the follow-up period (Table 3).

Revision

There was an overall revision rate of 15.2% ($n = 17$) during the follow-up period. The mean time to revision was 1.33 years (73 days–4.9 years) at a mean age of 75.9 years (30–93 years). Displaced fractures had a significantly higher revision rate ($p = 0.01$) independent of age, gender and time to follow up, with a revision rate of 24.4% for displaced fractures and 11.1% for undisplaced fractures.

The vast majority of patients requiring revision surgery either had fracture non-union (52.9%) or avascular necrosis of the femoral head (29.4%). A breakdown of the number of revision surgeries by Garden classification is included in Table 1.

For those under the age of 65, 10 revision surgeries were performed. This represents a revision rate of 25.6% in this age group. Significantly in this age group, displaced fractures had a revision rate of 43.8% (see Table 3).

For those aged 65 or older, the revision rate was 9.5%. However, in patients over 65 who were alive at time of follow-up, there was a rate of revision of 21.4%.

Detailed numerical breakdown of fracture numbers by age group, displacement with mortality and revision figures can be found in Table 3.

Table 2 Classification of intracapsular fractures by anatomical location

Fracture location	$N = 112$	Percentage (%)
Subcapital	34	30.36
Transcervical	48	42.86
Basicervical	30	26.79

Functional outcome

After excluding those who had revision surgery and deceased patients, our group for functional outcome analysis comprised of 38 patients. MHHS follow-up was completed by 82% ($n = 31$) of patients. There was no difference between the two groups with a mean MHHS score of 85.9 (± 16.9) for displaced fractures and 86.01 (± 18.8) for undisplaced fractures.

Those aged younger than 65 at the time of surgery had significantly better MHHS ($p = 0.02$). For those less than 65 years, there was a mean MHHS 91.14 (± 11.9) with a mean MHHS of 70.4 (± 20.8) in those aged 65 and over.

Discussion

In this busy tertiary referral centre in the West of Ireland, we analysed the outcomes following internal fixation for neck of femur fractures. As expected, we found significant levels of morbidity and mortality associated with these fractures and an increased risk of revision associated with fracture displacement. In terms of functional outcome, we found no difference between displaced and undisplaced fractures with marginally better functional outcomes in younger patients.

The dreaded complications following internal fixation of intracapsular fractures are avascular necrosis, fracture non-union or mal-union and ultimately revision surgery. These risks are increased with fracture displacement even in young patients and this is reflected in our finding of a significantly higher revision rate in displaced fractures. In line with current numbers from the IHFD, displaced fractures accounted for almost 48% of those undergoing internal fixation in our institution ($n = 41$). We found a revision rate of 24.4% for these fractures compared with 11.1% for undisplaced fractures. Most significantly, for those less than 65, the rate of revision approached 50% at 5-year follow-up. Similar to the findings of Rogmark et al. [7], we found that the vast majority of revisions occurred early, with no revision identified at more than 5 years post-operatively. However, a follow-up greater than 5 years was not complete for the entire study population.

In those patients who did not require revision, we found no difference in long-term functional outcome following internal fixation between displaced and undisplaced fractures. Excellent outcome scores were achieved for patients in both categories particularly in patients less than 65 years of age.

With regard to functional outcome, again most of the available data identified by a Cochrane review consisted of RCTs comparing arthroplasty techniques with internal fixation and was focused on elderly populations. Some of the available randomised controlled trials have found superior functional outcomes for arthroplasty; however, often, outcome reporting is of limited detail and short term, and validated outcome scores were not always used. Trials such as that by Davison et al. [8] found no difference in Harris hip scores or Barthel index up to 5 years post-

Table 3 Fracture classification by age group and level of displacement

Age group	Total	RIP	Revision	Classified (by Garden)		Total	Revision
Less than 65	39	8	10	33	Displaced	16	7
					Undisplaced	17	2
65 or older	73	45	7	53	Displaced	25	3
					Undisplaced	28	3

operatively between SHS and HA for displaced fractures. Chammout et al. [9] found a mean difference in Harris hip score of less than 5 points favouring arthroplasty at 10 years post-op. Three meta-analyses on the topic of displaced intracapsular fractures failed to conclude a benefit for arthroplasty or internal fixation in terms of functional outcome [5, 10, 11].

The advantages of internal fixation include retaining the native femoral head, less surgical trauma and reduced dislocation risk when compared to arthroplasty options [12]. However, arthroplasty allows earlier weight bearing and has lower reoperation rates meaning that it is the preferred treatment option in the majority of intracapsular fracture cases. There have been many randomised controlled trials which support the use of arthroplasty, in particular for displaced fractures in elderly patients [6, 11]. This is reflected in current practice in Ireland and the UK where the vast majority of displaced fractures and almost half of undisplaced fractures are treated by primary arthroplasty techniques [4].

Nonetheless, displaced fractures treated with internal fixation, particularly in younger patients, remain a clinically important group. Our results will allow clinicians to reliably predict outcomes for these patients if fracture fixation is being considered.

There are a large variety of implant types and fixation techniques used in the published trials on intracapsular fractures, with only a small proportion of trials using sliding hip screw (SHS) techniques. The vast majority of the intracapsular fractures treated by IF in our institution during this time period were treated using fixed angle sliding hip screw constructs, with only 4 fractures treated using cannulated screws. This is supported by the recently published FAITH trial, a multi-centre RCT, which found that those at high risk of non-union such as smokers and displaced fractures may benefit from the use of a SHS [13].

Given that our study was performed retrospectively, it does have some limitations. Despite the study including patients over a 5-year period, the numbers available for long-term follow-up were reduced significantly by the high mortality and revision rates in this population. A prospectively designed study would allow the collection of functional outcome data at intervals during the post-operative period and compare functional outcomes across the full spectrum of patients, including those who go on to require revision. This study only includes patients deemed clinically suitable for internal fixation taking the evidence for arthroplasty into account. We therefore have a more homogenous study population for the comparison of functional outcomes for displaced and undisplaced fractures. Potential for further study in this area exists in the form of long-term complete radiological follow-up for patients with displaced intracapsular fractures in particular. Additionally, 50% of displaced fractures in younger patients did not require revision and had a good functional outcome, further research may help identify radiological or physiological selection criteria to better identify these patients.

Conclusion

We have reported the 5-year mortality rate, revision rate and functional outcome in this cohort of patients who underwent internal fixation for neck of femur fractures. In addition, we have directly compared outcomes between displaced and undisplaced fractures. Though we have shown that an excellent functional outcome can be achieved with internal fixation, the risk of revision is significant particularly in displaced fractures in younger patients.

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