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ORIGINAL ARTICLE

# A growing problem: cycling referrals to the National Centre for Pelvic and Acetabular Fracture Management in Ireland

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## Abstract

**Background** Popularity in cycling continues to grow. In Ireland, in the last 5 years, 42% more people now use it to travel to work. This has been mirrored by a rise in cycling-related trauma and deaths. The popularity amongst men has led to the term middle-aged men in Lycra (MAMIL) being coined.

**Aims** The purpose of our study was to quantify cycling-related pelvic and acetabular fracture referrals in Ireland and determine injury patterns, cost and functional outcomes following these injuries.

**Methods** A retrospective cohort study was conducted of all referrals to our institution, the National Centre for Pelvis and Acetabular Fracture Management, in 2016 and 2017. Demographic, mechanism of injury, concomitant trauma and treatment data were analysed. Patients were contacted to assess return to work, sport and quality of life (EQ-5D-3L).

**Results** Cycling injury referrals increased by 90% between 2016 and 2017 with a greater number of cycling than motorbike injury referrals. Twenty-nine patients sustained a pelvic and acetabular (PA) injury while cycling. The mean patient age was 51.7 years of which 86.2% were male with 41% suffering a concomitant injury. Fourteen patients (48.3%) required surgery of which 60% have returned to cycling. Mean cost of treatment was €11,757. The median EQVAS was 80.

**Conclusions** The rise in popularity of cycling has been mirrored by an increase in PA injuries and deaths. These injuries are associated with significant costs to the patient, hospital and society. Greater investment in safety and awareness is needed to protect this vulnerable group.

**Keywords** Acetabular · Cost · Cycling · Fractures · Pelvis · Trauma

## Introduction

Pelvic and acetabular (PA) fractures account for a relatively small percentage of all fractures (0.4–5%) but are often associated with a high morbidity and mortality [1–5]. They are most commonly the result of high-energy trauma and associated with concomitant trauma in nearly two thirds of patients [1, 6, 7].

Cycling has been shown to provide a wide range of health, economic and environmental benefits [8, 9]. As a result, many countries have sought to promote it as both a means of transport and exercise. Cycling has continued to increase in popularity in a number of countries with 23% increase in the number of miles cycled in the UK between 2006 and 2016 while 27% of all trips in the Netherlands are made by bicycle [9, 10]. A similar trend has been seen in Ireland. National Census figures from 2011 to 2016 show that the number of people cycling to work has increased by 42.8% [11]. The popularity amongst men has led to the term middle-aged men in Lycra (MAMIL) being coined and this has now been recognised by the Oxford English dictionary [12].

Cycling however is not without its risks. A prospective study of 7100 fractures in 2013 by Court Brown et al. found 3.6% were the result of cycling [13]. As participation numbers in cycling have increased so have injuries associated with it, with a recent study showing a 200% increase in the number of referrals for bicycle-related trauma to the Irish National Spine Treatment Centre [14]. There has also been a 50% rise in cycling deaths in Ireland between 2016 and 2017 despite campaigns to raise awareness and safety around cycling such as "Overtaking Cyclists", "Vulnerable Road Users" and "Cyclists – We all share the road" [15, 16].

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The aim of our study was to quantify cycling-related pelvic and acetabular fracture referrals in Ireland over a 2-year period and determine injury patterns, cost and functional outcomes following these injuries.

## Materials and methods

A retrospective review was conducted of a prospectively maintained database of all pelvic and acetabular referrals received by our institution (Tallaght University Hospital) from January 1, 2016, to December 31, 2017. Our institution is the national referral centre for the assessment and treatment of all pelvis and acetabular fractures in the Republic of Ireland. All cases involving either a pelvic and/or acetabular fracture are referred via our online pathway from other hospitals to our institution where a decision regarding the management of the patient is made. Cases requiring operative intervention are transferred to our institution for definitive care. Patients are then transferred back to the referring hospital following surgery for rehabilitation care.

Data collected on the online referral pathway include patient demographics, diagnoses, other injuries, background medical and surgical history, medication, allergies, infection status, laboratory results, current status and treatment received to date. Images including plain film X-rays and computed tomography (CT) scans are reviewed either on the national imaging platform or else on disc.

In order to assure the accuracy of the database, the radiology database, theatre logbooks, patient medical records, electronic medical records and HIPE (hospital in patient enquiry) system were cross referenced. The HIPE system is the national Irish data collection source for all acute public hospitals. It collects demographic, clinical and administrative data creating an electronic record of each patient admission (diagnosis, investigations, procedures, consultations, etc.). Using this record, a casemix points score is calculated based on the complexity of the case and a cost- or activity-based tariff is created.

Patients who underwent operative intervention were contacted to assess details around the injury, return to work, cycling and quality of life assessed through the EuroQol-5D-3L questionnaire (EQ-5D). Informed consent was sought from all patients. The EQ-5D® is a standardised tool for use as a measure of health outcome. It consists of two parts, a descriptive system of assessing five domains, mobility, self-care, usual activities, pain/discomfort and anxiety/depression with each domain consisting of three levels: no problems, some problems, extreme problems. In this study, patients were divided into two groups "No Problems" (level 1) and "Problems" (levels 2 and 3). The second part is the EQ visual analogue scale (VAS) describing the respondent's self-rated health. Permission was granted from EuroQol Research Foundation for use of the EQ-5D questionnaire.

## Results

Over the 2-year study period, a total of 456 pelvic and acetabular referrals were made from 18 hospitals in the Republic of Ireland. The mean age of patients was 53 years (SD 21.5 years) of which 62.9% were male. Conservative management was undertaken in 60.7% ($n = 277$), while 38.2% ($n = 174$) underwent operative intervention and 1.1% ($n = 5$) patients died prior to transfer. Of the 456 referrals, 29 referrals (6.4%) were for cycling-related trauma while 26 referrals (5.7%) were for motorbike-related trauma. In 2016, there were 10 cycling-related referrals with 19 in 2017, representing a 90% increase (Table 1).

Of the 29 referrals, the mean patient age was 51.7 years (SD 14.2 years) of which 86.2% were male. Five patients (17.2%) initially presented to hospital with no orthopaedic services and required transfer to another hospital for definitive care. More than two thirds of patients had no comorbidities (69%). The majority of falls from a bicycle (89.7%) occurred on the road with three patients (10.3%) sustaining injuries while mountain biking (Figs. 1 and 2). Summer was the most common season of injury (39%).

Acetabular fractures occurred in 24 patients (82.8%), 3 patients experienced pelvic fractures and 2 patients iliac wing fractures (Tables 2 and 3). Twelve patients (41.4%) suffered a concomitant injury, of which three patients sustained a head injury, three patients a cervical spine injury and seven patients an upper limb fractures. Of the 29 patients, 14 patients (48.3%) underwent surgery to treat their PA injuries. Ten patients underwent acetabulum open reduction internal fixation (ORIF), one patient external fixator application and sacroiliac screw insertion and one patient iliac wing ORIF and one patient initial external fixator application with subsequent pubic symphysis ORIF (Figs. 1 and 2). One patient underwent evaluation

**Table 1** Demographic data of cycling-related referrals for 2016 and 2017

| | Number | Percent |
|---|---|---|
| Total no. of referrals | 456 | |
| Cycling referrals | 29 | 6.4 |
| 2016 | 10 | |
| 2017 | 19 | |
| Mean age, years (range) | 51.7 (17 to 71) | |
| Gender, male | 25 | 86.2 |
| Patients with comorbidities | 9 | 31 |

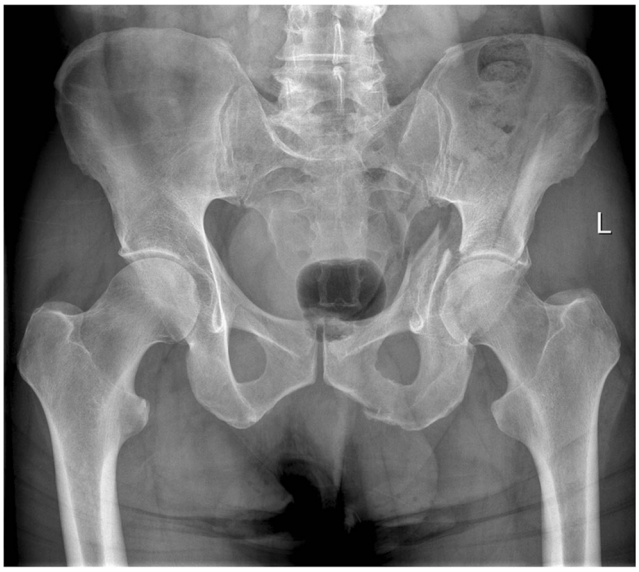


**Fig. 1** Presenting X-ray of a 58-year-old male following a fall from a bicycle

under anaesthesia where the fracture was deemed stable on manipulation. Of those who required operative management, median length of stay was 6 days (range 2–34 days). Mean cost of treatment was €11,757 (Table 3).

Thirteen of the 14 patients (92.8%) who underwent operative intervention were contacted for follow-up, with a mean time of follow-up of 15.7 months. Of these patients, most injuries (69.2%) occurred while cycling for exercise purposes with just four patients injured while commuting. The majority of injuries (76.9%) did not involve another vehicle, person or animal. Just three patients reported the weather was wet or windy at the time of injury while all but one patient were wearing a helmet. Since injury, 10 patients have returned to work with eight patients (61.5%) also returning to cycling.

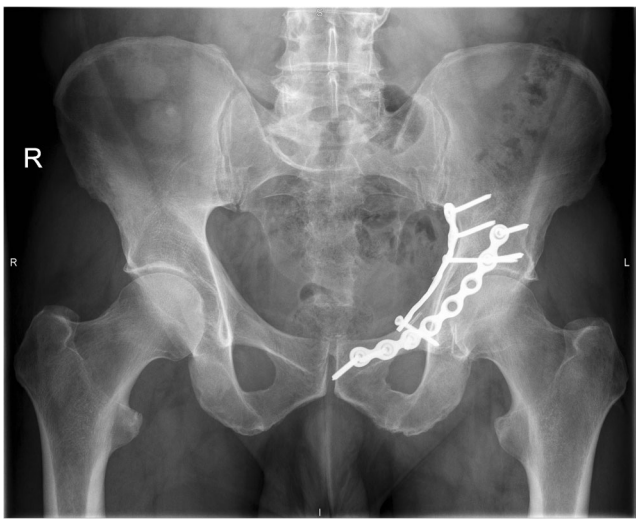


**Fig. 2** Post-operative X-ray 18 months later of Fig. 1

**Table 2** Demographic data of patients who underwent operative intervention

| | Number | Percent |
|---|---|---|
| Total | 14 | 48.3 |
| Mean age, years (SD) | 49.3 (12.3) | |
| Gender, male | 12 | 85.7 |
| Length of stay, median (days) | 6 | |
| Mean cost of treatment | €11,757 | |
| Length of follow-up, mean (months) | 15.7 | |
| Return to work | 10 (of 13) | 76.9 |
| Return to cycling | 8 (of 13) | 61.5 |

Over half of patients (61.5%) who underwent operative intervention reported experiencing some problem with mobility and performing usual daily activities following injury. One in two patients reported experiencing some pain or discomfort while three patients continue to take daily pain relief following the injury (Table 4). The median EQVAS was 80 (60, 25th percentile; 95, 75th percentile).

## Discussion

Over the 2-year study period, there was a 90% increase in cycling-related acetabular and pelvic fracture referrals mirroring the 50% increase in cycle-related deaths in Ireland over the same time period. As seen in other recent studies, cycling-related trauma accounted for a larger percentage of referrals than motorbike-related trauma [14].

Cycling in Ireland has increased in popularity as a result of a number of incentives to increase participation such as tax deductions on the purchasing of bikes, investment in cycling

**Table 3** Classification of pelvis fractures (Young-Burgess) and acetabular fractures (Letournel)

| | Number | Percent |
|---|---|---|
| Acetabular fracture | | |
| Posterior wall | 2 | 6.9 |
| Anterior wall | 1 | 3.5 |
| Anterior column | 5 | 17.2 |
| Associated both columns | 5 | 17.2 |
| Transverse/posterior wall | 1 | 3.5 |
| Anterior column/posterior hemitransverse | 10 | 34.4 |
| Pelvis fracture | | |
| LC1 | 1 | 3.5 |
| LC2 | 1 | 3.5 |
| Vertical shear | 1 | 3.5 |
| Iliac wing | 2 | 6.9 |

**Table 4** EQ-5D-3L by "No problems" level 1, "Problems" (levels 2 and 3)

| | | Numbers | Percent |
|---|---|---|---|
| Mobility | Problems | 8 | 61.5 |
| | No problems | 6 | 38.5 |
| Self-care | Problems | 4 | 30.8 |
| | No problems | 8 | 66.6 |
| Usual activity | Problems | 8 | 61.5 |
| | No problems | 6 | 38.5 |
| Pain/discomfort | Problems | 7 | 53.8 |
| | No problems | 7 | 46.2 |
| Anxiety/depression | Problems | 4 | 30.8 |
| | No problems | 8 | 69.2 |

infrastructure and public bike-sharing schemes [17, 18]. Participation has particularly increased in men aged between 40 and 60, so-called MAMILs, due to a number of different factors including physical health, mental health and technology [19]. Our study found a majority of referrals were for those who matched this cohort (86.2% male, mean age 51.7 years) of which the majority had no medical comorbidities (69%). Severe cycling injuries, including traumatic brain injury, spinal injury and pelvic and acetabular injury, are most commonly seen in this cohort of patients likely due to the greater participant numbers, miles cycled and lower bone mineral density [14, 20, 21]. Bone mineral density has been found to be significantly lower in recreational athletes who engage in non-weight-bearing activities such as cycling compared with weight-bearing activities such as running [20].

Cycling accounts for approximately 3.6% of all fractures and 10% of sports-related fractures [13, 22]. Upper limb fractures account for 85–90% of these fractures with pelvic and acetabular injuries making up a small percentage 1–2%. To our knowledge, very few pelvic and acetabular fractures caused by cycling have been reported in the literature [13, 22–24]. However, our study does highlight while these injuries are rare they are occurring with increasing frequency. Figures from the UK show that 3397 cyclists suffered serious injuries in 2016 while 102 fatalities occurred [25]. While cycling-related fatalities have remained stable in the UK, since 2008 (between 100 and 118) the number of cyclists suffering serious injuries has been rising since 2004. The exact extent of cycling injuries in Ireland is poorly understood. Figures from the Irish Road Safety Authority in 2012 reported 630 cyclists were injured; however, a more recent study in 2017 from a single Dublin emergency department reported 534 cycling-related presentations over a 1-year period [25, 26].

The majority of patients in our cohort, 82.8%, sustained acetabular fractures of which 10 patients (34.5%) required open reduction and internal fixation. Management of these patients is complex with complication rates as high as 45% and approximately 26.6% experiencing post-traumatic arthritis [7, 27]. This young subgroup of patients have an increased risk of requiring future total hip arthroplasty, with rates of approximately 8–13% within 1 year in some cases [5, 8, 27]. In our study at the time of follow-up, two patients had undergone total hip replacement less than 1 year since injury. The mean cost of treatment for patients who underwent surgery was €11,757. However, this figure underrepresents the true cost as it does not include the cost of treatment at the initial presentation and post-operative rehabilitation at the referring hospital once the patient has been repatriated. For those who underwent surgery and were contacted, 76.9% (10 patients) had returned to work while 61.5% (eight patients) had returned to cycling. These injuries are associated with a significant personal and financial impact to patients, their families and society as a result of absence from work, prolonged rehabilitation and possible long-term consequences.

Our study is not without its limitations. Only patients who underwent operative intervention were followed up as patient contact details were not available for those who were not transferred to our institution. While the database is prospectively maintained, it is reliant on the quality of information received from other institutions. All data was extensively cross referenced from multiple sources to ensure it was as accurate as possible. As noted above, the cost of treatment is an underrepresentation of the true costs of care. This is the largest study looking at pelvis and acetabular fractures in cycling injuries to date and an area where little is known.

The rise in popularity in cycling has been mirrored by a rise in PA-related cycling injuries and death. Cycling-related trauma has now surpassed motorbike trauma as a cause of pelvis and acetabular fractures. As participation in cycling grows, increased investment in awareness and safety needs to be focused at protecting this vulnerable group of road users. Pelvis and acetabular fractures are associated with significant costs to the patient, healthcare providers and society as a whole.

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## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Research involving human participants** All procedures performed in this study involving human participants were in accordance with the ethical standards of the institution and with the 1964 Helsinki Declaration and its later amendments.

**Informed consent** Informed consent was obtained from all individual participants in the study.

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