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Dynamic locking plate vs. simple cannulated screws for nondisplaced intracapsular hip fracture: A comparative study

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ABSTRACT

Introduction: Intracapsular hip fractures (ICHF) are a common cause of morbidity and mortality and pose a great economic burden on the health care systems. Appropriate surgical treatment requires balancing optimal outcomes with the cost of treatment to the health care system. While in elderly patients with displaced ICHF arthroplasty became the standard of care, the internal fixation method for conserving the femoral head in younger patients or in nondisplaced ICHF is still in debate. We compared a dynamic locking plate with the standard cancellous cannulated screws (CCS) for treatment of nondisplaced ICHF.
Methods: All patients treated with internal fixation for nondisplaced ICHF between July 2009 and December 2012 at our level one trauma center were included in this study. Patients treated with Targon FN (Aesculap) implants and CCS (Synthes) were compared. Charts were reviewed for demographics, intraoperative data and peri/post operative complications retrospectively. Radiographical analysis, pain (VAS), quality of life (SF12) and function (MHHS) data were prospectively gathered.
Results: One hundred and fifteen non-displaced ICHFs were treated with internal fixation, 81 with CCS and 34 with Targon FN implant; the mean follow-up was 19 and 28 months, respectively. Group fracture characteristics (Garden/Powel classification), and demographics, excluding age, were not significantly different. Post-operative revision rates of the Targon FN and CCS groups, perioperative complications were not statistically different ($p > 0.05$). Quality of life (SF-12), function (Modified Harris Hip Score) and Visual Analogue Scale (VAS) pain scores were not statistical different.
Conclusions: Complication rates and clinical outcomes for the treatment of nondisplaced ICHF with Targon FN and SCC showed no significant differences. Based on this evidence in consideration of the substantial cost differential between the Targon FN and SCC we suggest SCC for treatment of nondisplaced ICHF.
Level of Evidence: III

Introduction

Hip fractures are a prevalent injury in the elderly population [1] and major cause of morbidity and mortality [2]. The number of hip fractures is projected to increase dramatically due to the aging population. Health care costs will increase in parallel, becoming a substantial economic burden [3]. Thus, it is imperative to reduce the associated costs of treatment while improving clinical outcomes for these patients.

Intracapsular hip fractures (ICHF) typically result from low energy falls and account for approximately 50% of all hip fractures [4]. Prevalence data reports that between 32 and 38 percent of all ICHF are nondisplaced [5,6]. Nondisplaced ICHF can be classified by the Garden system into Garden I–valgus impacted fractures and Garden II–non-displaced fractures [7]. Closed reduction and internal fixation with cannulated screws is currently the benchmark procedure for nondisplaced ICHF [8] as studied by Chen et al. [8]. However, studies looking at nondisplaced ICHF have found secondary displacement of ICHF to be a major complication of treatment with rates of up to 5% [9] and re-operation rates of up to 19%. Chen et al. [8] studied the treatment of non-displaced ICHF in the elderly and found the overall failure rate was 16.22% in the relatively small cohort of 37 patients. Multiple reports have

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described sub-optimal clinical outcomes in the treatment of nondisplaced ICHF [5,8–13].

In an attempt to remedy the largely mechanical mechanism for secondary displacement complications and improve clinical outcomes, Aesculap introduced the Targon FN device. This device is a fixed angle locking plate designed to allow for stable angular attachment of telescoping screws. Its design is aimed at reducing the risk of femoral-head rotation and preventing fracture displacement into secondary varus subluxation (Fig. 1A).

Biomechanical analysis of a femoral neck locking plate (FNLP) demonstrated increased mechanical stiffness with decreased rotation and tilting [14]. Initial clinical results by Parker, Cawley and Palail [10] found decreased revision rates with the Targon FN. Biber, Brim, and Bail [15] demonstrated low general complication rates and Korver et al. [16] published further encouraging data regarding the Targon FN device. These papers investigated both displaced and nondisplaced ICHF (Garden type 1–4) without comparison to an internal control. Further comparative investigation specifically examining the Targon FN device for the treatment of nondisplaced (Garden type 1 and 2) ICHF is warranted. To the best of our knowledge, this is the first study comparing the Targon FN device to standard treatment with simple cannulated screws for nondisplaced ICHF.

Table 1
Demographic and fracture classification data.

	CCS	Targon FN	*p*-value
Total number	81	34	
Gender			0.015
Male (%)	20 (24.7%)	17 (50%)	
Female (%)	61 (75.3%)	17 (50%)	
Side			0.541
Right	39	19	
Left	42	15	
Mean age [SE] years	77.7 [2.48]	66.8 [1.48]	<0.001
Age male	73	63.7	
Age female	79	69	
Garden stage (%)			0.09
1	66 (81.48%)	22 (64.7%)	
2	15 (18.52%)	12 (35.3%)	
Pauwels (%)			0.605
1	13 (16%)	4 (11.76%)	
2	53 (65.43%)	26 (76.47%)	
3	15 (18.56%)	4 (11.76%)	
Mortality	12	2	0.226
Follow up [Std. Error] (months)	19 ± 1.9 (14.45–50.7)	28 ± 1.3 (14.43–42.2)	0.006

This table represents the demographic data recorded for the CCS and Targon FN cohorts during the study period. Data regarding the classification of fractures, mortality, and the follow up period is also presented.

Methods

The institutional review board approved this study. Data from July 2009 to December 2012 was retrospectively gathered and reviewed. The indications for internal fixation of ICHF at our institution include nondisplaced or minimally displaced fractures (Garden 1/2).

A total of 785 intracapsular hip fractures presented to the trauma center during the study period. We identified 156 patients with intracapsular hip fractures that were treated with internal fixation. Of these patients, forty-one were treated with closed reduction internal fixation (CRIF) for a displaced ICHF, not meeting inclusion criteria. The remaining 115 (15%) patients had nondisplaced fractures, qualifying them for the study. Patients were further subdivided by method of surgical fixation. Two groups were selected; patients treated CCS (three cannulated screws diameter: 7.3 mm with distal threads) and Targon FN (Targon FN device with three telescoping screws diameter: 6.5 mm) (Fig. 1a and b).

Each fracture was classified according to Garden and Pauwels classifications (Table 1). Surgery was performed within 48 h from patient presentation at the trauma center, unless otherwise medically contraindicated. Postoperative care was standardised for both the CSS and Targon FN cohorts. Radiological evaluation of AP and axial films were performed by two orthopedic surgeons (NS and YV). Fracture healing was defined as union in three cortices. Complications including non-union, mal-union, avascular necrosis, cut out and periprosthetic fractures were recorded. Prospective clinical outcome data including the Visual Analogue Pain scale (VAS), Short Form-12 (SF-12) and the modified Harrison's hip score were all collected at final follow up.

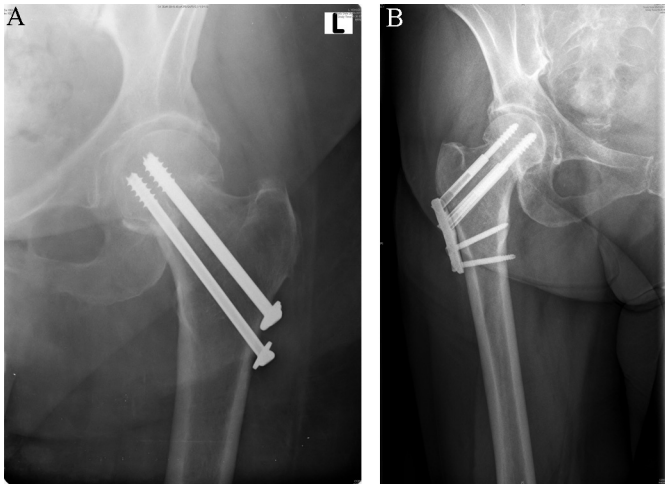

Fig. 1. (a) This image is a standard X-ray of a patient status post fixation via CCS for ICHF. (b) This image is a standard X-ray of a patient status post fixation via Targon FN for ICHF.

Statistical analysis

Statistical analysis of the data was carried out with the χ^2 or Fisher exact test for categorical variables, Mann-Whitney Test for ordinal variables and Student *t*-test or Kruskal–Wallis test with a significance level of .05. IBM SPSS software for Windows, version 21 (IBM, Armonk, NY) was used for all analyses.

Results

Our study compared 81 (70%) patients treated with CSS to 34 (30%) patients treated with Targon FN for ICHF. The mean age of patients in the Targon FN group was 66.8 years of age while the mean age of the CSS group was 77.7 years of age. The Targon FN group was thus significantly younger than in the CSS group ($p < 0.001$). As one measure of success in treating patients, mean outcome scores were recorded using the MHHS, a VAS pain scale, and the SF-12 physical and mental assessment forms. On the MHHS patients in the CSS group recorded an average score of 49 vs. 56 ($p = 0.373$) for the patients in the Targon FN group. Patients in the CSS group reported significantly less pain on a VAS pain scale then those in the Targon FN group (3.086 vs. 4.5 mean VAS; $p = 0.009$). When compared using the SF-12 physical questionnaire, the CCS group scored 40.3 vs. 39 for the Targon FN group ($p = 0.67$). On the SF-12 mental questionnaire form, CSS patients recorded and average score of 53.6 vs. 51.3 in the Targon FN group ($p = 0.321$) (Table 2).

During the study period a total of 9 orthopedic complications were recorded. The CSS group experienced 7 complications whereas there were 2 complications in the Targon FN group, however the complication rate was not significantly different