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Original article

Intramedullary nailing through a suprapatellar approach. Evaluation of clinical outcome after removal of the device using the infrapatellar approach

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Summary. *Background and aim of the work:* Since 2006, It has been developed the possibility to introduce a tibia nail through a suprapatellar access. However, the removal of device must be carried out using the classic infrapatellar approach. The aim of this study is to evaluate the clinical scores of a group of patients that removed a tibial nail by infrapatellar approach, previously introduced through a suprapatellar access. *Methods:* Seven patients received removal, through infrapatellar access, of tibial nail previously introduced by suprapatellar approach. Despite being VAS <5, patients requested the device to be removed. The variables studied were the distance between the apex of the nail and the tibial plateau (TPD) and between the apex of the nail and the anterior tibia (ATD), oxford knee score (OKS), Kujala score (KJS), Visual Analog Scale (VAS) and SF 36 before surgery and 1 year. A1 year of follow up the Sidky-Buckley questionnaire was administered. The follow-up was 1 year. *Results:* The mean VAS was 2.8 before surgery and 0.5 at 1 year after surgery, OKS average pre-surgery is 38 (good), while at 1 year it becomes 44 (excellent). The Sidky-Buckley questionnaire showed that all patients would have the intramedullary nail removed again. The widest improvement in all parameters is seen in the two patients with less distance from the tibial plateau. *Conclusions:* Although the patients had received initial suprapatellar access and a second infrapatellar for the removal of the device, no complications were reported regarding the use of the two accesses. (www.actabiomedica.it)

Key words: removal tibial nail, suprapatellar approach, removal using the infrapatellar approach

Introduction

The infrapatellar approach for the nail insertion has long been considered the standard procedure, however high incidence of anterior knee pain (1), ranging from 10 to 80% (2,3), has been reported. Thus in 1996 Tornetta and Collins (4) developed a semi extended nailing technique who employed a medial parapatellar approach with lateral subluxation of the patella, and since 2006 the suprapatellar approach for extended knee tibial nailing has gained popularity (5). Several recent studies compare suprapatellar and infrapatellar approaches for intramedullary tibial nail showing that suprapatellar nailing has advantages over infrapatellar nailing (6-9). Those advantages are even more evident when related to specific indications, such as proximal third of tibia (10).

Techniques in nail removal might be another aspect to study when comparing infrapatellar and suprapatellar approaches as around 30% of patients with

intramedullary tibial nail asks for removal (11). Indications for the removal of internal fixation may include knee pain, infection, or patient preference (12).

Nails introduced with an infrapatellar access could be removed trough the same access, whereas it is necessary to use a different access (infrapatellar) for the device removal when a suprapatellar approach has been used.

To our knowledge no study evaluates patients who underwent removal of a suprapatellar tibial nail through an infrapatellar approach, although some studies in literature analyze results of removal of nail inserted via infrapatellar access (13, 14).

The aim of this study is to evaluate the clinical scores of a group of patients that removed a tibial nail by infrapatellar approach, previously introduced through a suprapatellar access.

Patients and methods

From November 2015 to December 2016, seven patients that received removal through infrapatellar access, of the tibia nail previously introduced by suprapatellar approach were enrolled in our study.

Inclusion criteria were: tibial or tibiofibular fracture treated with intramedullary nail introduced through the suprapatellar approach and removed via infrapatellar access; healing of the fracture; age over 18 years and under 60 years old; decision of the patient to remove the nail even if VAS (Visual Analog Scale) score before surgery was <5. This last criterion was insert in order to better understand if the use of two access, the suprapatellar and the infrapatellar, could lead to complications. Exclusion criteria were: pathological fracture; ipsilateral femur fracture; previous knee surgery; presence of early osteoarthritis.

All patients underwent surgical procedure for the removal of the implant by the same surgeon (MM). They were placed in the supine position and received a regional anesthesia.

All locking screws except one of the proximal locking screws were removed, then screw the extraction screw into the nail and tighten it to prevent rotation or displacement of the nail posteriorly below the tibial plateau. For the exposition of the nail apex, the incision starts proximally at the distal third of the patella along the patellar ligament, and a transpatellar approach was used. Intravenous administration of tranexamic acid and elastic bandage ware routinely used. No drainage was used in the post-operative. Patients were encouraged to flex and extend the knee immediately after surgery. Partial weight-bearing was given for 1 week and then a complete weight-bearing was given.

The clinical variables studied were oxford knee score (OKS), Kujala score (KJS), Visual Analog Scale (VAS), SF 36 before surgery and 1 year. The radiological variables were the tibial plateau distance (TPD) that is the distance between the apex of the nail and the tibial plateau and the anterior tibial distance (ATD) that is the distance from the apex of the nail and the anterior tibial profile (Fig. 1). At 1 year of follow up the Sidky-Buckley questionnaire was administered (13). The minimum follow-up was 1 year. Data were recorded by two independent orthopedic surgeons (GN and CF), and the value reported in table 1 and 2 were the average of the two measurements.

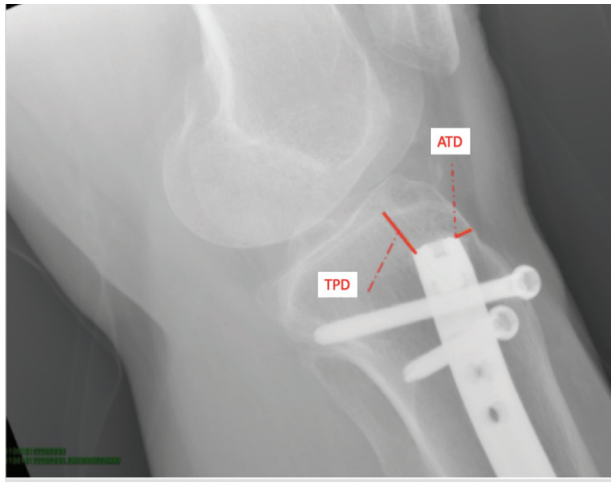

Figure 1. Pre-operative X-Ray that shows the tibial plateau distance (TPD) that is the distance between the apex of the nail and the tibial plateau and the anterior tibial distance (ATD) that is the distance from the apex of the nail and the anterior tibial profile

Table 1

	Sex	Age	VAS pre-op	VAS 1 year FU	rifarebbe	Kujala pre-op	Kujala 1 year FU	OKS Pre-op	OKS 1 year FU	DP	DT
BMC	F	43	2	2	2	70	92	31	40	13,06	7,12
MI	F	61	3	0	2	96	98	43	48	10,95	6,70
GE	M	39	4	0	2	70	88	35	47	3,99	13,43
DDA	M	54	2	0	2	93	97	46	47	12,59	6,49
RD	M	55	2	0	2	80	90	36	44	11,07	7,66
BR	F	44	2	1	2	94	97	44	48	12,34	8,90
BE	M	40	4	0	2	67	90	37	40	2,99	12,47
Average											

Table 2

	PF PRE-OP	PF 1 Y FU	P PRE-OP	P 1 Y FU	HP PRE-OP	HP 1 Y FU	CH PRE-OP	CH 1 Y FU	EV PRE-OP	EV 1 Y FU	MH PRE-OP	MH 1 Y FU	SC PRE-OP	SC 1 Y FU
BMC	55	80	67	89	55	60	50	75	75	75	84	84	78	89
MI	75	80	56	89	65	65	25	75	85	90	80	96	89	89
GE	55	90	65	90	53	70	50	75	75	75	80	84	78	90
DDA	80	80	89	100	65	65	50	50	75	80	96	96	78	89
RD	82	83	90	100	65	70	45	50	75	85	94	96	82	89
BR	60	75	70	89	55	60	50	70	70	75	82	84	80	88
BE	54	88	60	90	53	75	50	75	70	75	83	86	76	88
Average														

SF-36 COMPONENT LEGEND

Physical Function (PF)
Pain (P)
Health perceptions (HP)
Change in health (CiH)
Energy / Vitality (EV)
Mental Health (MH)
Social Function (SC)

Results

We enrolled 7 patients (3 females and 4 males). The median age was 49 years. (range 39-55).

There were five cases of tibial fractures alone and two cases of tibiofibular fractures, of which one AO 41-A1, one AO 43-A1, two AO 42-A1, one AO 42-A2, one AO 42-A1, one AO 42-C2 and two cases of fibular fracture AO-4F3A (Muller Arbeitsgemeinschaft fur Osteosynthesefragen).

The fibular fractures were treated using osteosynthesis with plate which were removed together with the nail.

All wounds healed and no post-operative infection or fracture occurred after the removal of the nail. The mean VAS score was 2.8 before surgery and 0.5 at 1 year after surgery. The mean KJS pre-surgery was 81 and 93 post-surgery, OKS average pre-surgery is 38 (good), while at 1 year it becomes 44 (excellent) (Fig. 2, 3). The mean TPD was 11.43 (two patients with TPD <4), whereas the mean ATD distance was 8.96. Considering SF 36 there is an improvement in the parameters of physical health, passing from an average physical activity of 66 to 82 to a year and from 71 to 92 in the pain parameter. The general health parameter also goes from an average of 49 to 66. From the Sidky-Buckley questionnaire it was found that all patients would have the intramedullary nail removed (13). The widest improvement in all parameters is seen in the two patients with the less distance from the tip of the nail to the tibial plateau. This result confirms the results of Zhang et all. and give a great importance to the nail length in order to sink the nail and to reduce the tibial plateau distance (TPD) (14, 15).

Figure 2. Range of motion at 1 year after the remove of the device

Figure 3. Range of motion at 1 year after the remove of the device

Discussion

Suprapatellar technique for intramedullary tibial nailing is becoming more popular over the years. The semi-extended position for intramedullary nailing of the tibia is particularly useful when treating difficult metaphyseal and metadiaphyseal proximal tibia fractures (4), as obtaining an acceptable reduction is very difficult in traditional infrapatellar approach due to the muscle forces that act on the fracture site. The fracture of the proximal third of the tibia, in fact, result in a varus deformity due to the quadriceps muscle and gastrocnemius muscle. Moreover, this tibial segment is difficult to visualize when the tibia is more than 40cm long, because the image intensifier impinges on the entry wire (10). It is reported 58% of malreduction in tibial fracture of the proximal third after an infrapatellar tibial nail (16). The semi-extended position has a role as a useful technique in polytrauma patients for several reasons. It facilitates the positioning of the C-Arm, thus reducing the intraoperative fluoroscopy time (5), avoid flexion or hyperflexion of the knee (e.g. in patient with pelvis fractures) (17).

In the literature, several studies have compared suprapatellar versus infra-patellar approach for tibia intramedullary nailing showing that suprapatellar approach led to a significant shorter fluoroscopy time and better sagittal plane alignment and lower incidence of angular malalignment without increasing risk of postoperative complications (7, 18).

The first concern reported is that suprapatellar approach might damage the patello-femoral joint during nail insertion as well as others intra-articular structures due to inability to achieve an accurate entry point for nail insertion. Reviewing the literature there are in vivo and cadaveric studies showed no chondral damages when suprapatellar approach is used (6, 19). Moreover, modern instrumentation used a specific cannula system to reduce the risk of iatrogenic damage to the surrounding articular cartilage, allowing safe nail insertion (17). Gelbke's cadaveric study quantified the peak pressures within the patella-femoral joint, comparing suprapatellar and infrapatellar approach, showing that for both techniques, the peak pressures were below the thresholds that have been reported to be detrimental to the joint cartilage (20). However,

even when signs of chondral damage are present, patients are rarely symptomatic (6).

A second concern regarding suprapatellar approach is the necessity of a different entry point for the eventual removal of the nail. To our knowledge no studies have been made to analyze the outcome of infrapatellar removal of a suprapatellar inserted nail. Also, regarding removal of infrapatellar inserted nail only a very few articles have analyzed outcomes, so indications for removing the device remain discussed (13, 14). Sidky et all analyzed 130 patients (134 fractures) that removed their implant, showing that 72,2% of patients had an improvement in their symptoms and surprisingly they showed as sex (female) and litigation are positive predictive factors for patient requests to have tibial nail removed (13). The study conducted by Zhang et all. for the first time managed to give us radiological bases for the removal of the nail. In fact, patients with a short distance from the tip of the nail tail to the tibial plateau (<10 mm) and to the anterior border of the tibia (<6 mm) has a VAS score ≥ 4 and relieved pain significantly after the removal of the nail (14).

The limitations of the present study are the absence of a control group, and the small sample size. Strengths of the study are the use of multiple subjective and objective functional scores, and most of all it is the first study in the literature analyzing infrapatellar removal of suprapatellar inserted tibial nail.

Conclusions

Although a small number of patients, our study reports no complications regarding the use of the two accesses, in patients that received initial suprapatellar access and a second infrapatellar for the removal of the device. However, the removal through infrapatellar access, of a tibial nail, previously introduced with suprapatellar access, has shown good clinical results. An improvement in the physical and mental health and an improvement in the clinical scores was observed. The two patients with less distance from the tip of the nail to the tibial plateau had the highest improvement in all parameters as demonstrated by Zhang et all (14).

The work was done at the department of Orthopaedics Traumatology and Spine surgery, Catholic University, "A. Gemelli" University Hospital, Largo A. Gemelli 8, 00168, Rome, RM, Italy.

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