



Original Article

Knee arthroplasty with rotating-hinge implant: an option for complex primary cases and revisions[☆]



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ABSTRACT

Objective: To present the indications, technical aspects, and initial results of the first cases using Endo-Model™ implants in Brazil.

Methods: A prospective study was conducted. It included nine patients submitted to a total knee arthroplasty, of which six were primary and three were revisions, using exclusively the Endo-Model™ implant. These patients were followed for an average of 12 months and evaluated with functional scores, such as the Knee injury and Osteoarthritis Outcome Score (KOOS), Knee Society Score (KSS), and visual analog pain scale (VAS).

Results: There were statistically significant improvements in all scores evaluated in every patient. Only one complication occurred postoperatively (apraxia of the peroneal nerve) and did not require surgery revision.

Conclusion: The use of a rotating-hinge implant for knee arthroplasty is a new option for complex cases with severe instability in Brazil; the initial results are satisfactory.

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Artroplastia de joelho com implante constricto e rotatório: uma opção para casos complexos primários e de revisão

RESUMO

Objetivo: Apresentar as indicações, os aspectos técnicos e os resultados iniciais dos primeiros casos do uso do implante constricto Endo-Model® no Brasil.

Métodos: Foi conduzido um estudo prospectivo que incluiu nove pacientes submetidos a artroplastia total de joelho, seis primárias e três revisões, exclusivamente com o implante Endo-Model®. Esses pacientes foram acompanhados por uma média de 12 meses e avaliados com os escores funcionais do Knee Injury and Osteoarthritis Outcome Score (KOOS), Knee Society Score (KSS) e escala visual analógica de dor (EVA).

Palavras-chave:

Artroplastia do joelho

Articulação do joelho

Amplitude de movimento articular

Instabilidade articular

Prótese do joelho

[☆] Study conducted at the Universidade de São Paulo, Faculdade de Medicina, Hospital das Clínicas, Instituto de Ortopedia e Traumatologia, Divisão de Cirurgia de Joelho, São Paulo, SP, Brazil.

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Resultados: Todos os escores avaliados apresentaram melhorias estatisticamente significativas em todos os pacientes. Somente uma complicação pós-operatória foi observada (apraxia do nervo fibular), sem necessidade de revisão da cirurgia.

Conclusão: O uso de implante em dobradiça rotatória em artroplastia de joelho é uma nova opção para casos complexos com instabilidade grave no Brasil, com resultados iniciais satisfatórios.

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Introduction

Due to population aging and, consequently, the increase in the number of osteoarthrotic patients, indications for total knee arthroplasty (TKA) and its revision are increasing.¹ Conventional implants are used in most cases, but a portion of the patients may present severe involvement of the ligamentous structures, severe deformities, or bone loss, which require a completely constrained implant.^{2,3}

Hinge prostheses are a solution for instability in more severe cases, but they have the disadvantage of a higher stress transmission to the bone-implant interface and a non-physiological movement pattern.^{2,4,5} Femoral and tibial nails are necessary to tolerate this greater stress and to prevent early implant loosening.⁵ Furthermore, the volume occupied by the hinge components requires bone resections greater than those made in conventional implants. Rotating-hinge implants are an evolution of fixed hinge models, which combine the flexion-extension movement with rotation, improving the mechanics of movement and decreasing stress transmission with the fixation.^{4,6}

Recently, the rotating-hinge prosthesis (Waldemar LINK GmbH and Co, Hamburg, Germany) became available in Brazil. This model consists of a metal hinge, its axis resting on a polyethylene surface (Fig. 1). The implant allows a flexion-extension amplitude of 0–165°. In extension, there is no rotation between the components. At 120° of flexion, there is internal rotation of 50° and external rotation of 35°. The model uses cemented femoral and tibial nails and has a metal trochlea that articulates with the patella.

This study is aimed at presenting the indications, technical aspects, and initial results of the first cases with the use of the Endo-Model® implant in Brazil.

Material and methods

Indications

The suggested indications for the use of a rotating-hinge prosthesis are patients with at least one of the following conditions⁷:

- Total insufficiency of one of the collateral ligaments;
- Massive bone destruction of the tibial plateau or femoral condyles, with loss of ligament origin or insertion;

- Ligamentous hyperlaxity, with large flexion or extension gaps;
- Fixed varus or valgus deformity greater than 20°;
- Severe rheumatoid arthritis;
- Neuromuscular diseases that occur with excessive knee hyperextension.

Moreover, gross differences in extension and flexion gaps and rigid knees in which the ligamentous release required for mobility gain impairs balance and stability are clinical situations in which this type of implant may be useful.

Another widely accepted possible indication for this type of implant is TKA infection, since the stability of the components allows an aggressive debridement of soft tissues, including complete resection of the joint capsule and collateral ligaments if so required for the control of an infectious process.⁸

Relative contraindications would be patients aged less than 75 years in whom stability can be achieved using non-constrained implants.⁷

Surgical technique

A medial skin incision in the knee and a routine transquadriceps medial parapatellar access were used. Complete disinsertion of the lateral and medial collateral ligaments can be performed if necessary, which greatly facilitates exposure and avoids excessive traction maneuvers in cases of large retraction of one of the knee compartments.

On the femoral side, the canal is manually widened to achieve the desired nail diameter. The size of the femoral implant is defined to better conform to the patient's anatomy; attention is paid to the point of emergence of the cut in the anterior cortical. The rotation of the femoral component is determined immediately before beginning the cuts, which are made free hand, using the biepicondylar line or the Whiteside line as a reference. Correct rotation is paramount for a good patellofemoral tracking. Subsequently, sequential cuts and drillings are made by using appropriate instruments; the distal femur is shaped to receive the implant.

On the tibial side, after determining the appropriate entry point of the intramedullary nail according to preoperative planning, the canal is manually widened to achieve the desired diameter. The tibial cut is made with a saw guide, based on the placed intramedullary nail, 90° from the mechanical axis and with a neutral tibial slope, 10mm distal to the surface of the tibia in primary cases. For revision cases, the tibial platform may be raised with a polyethylene block, should this be necessary. The rotation of the tibial component is



Fig. 1 – Endo-Model® Rotational Knee Implant (Waldemar LINK GmbH and Co., Hamburg, Germany).

determined by aligning the center of the platform with the middle third of the tibial tuberosity. Subsequently, drills and bone rasps are used to finalize the metaphysis to receive the component.

The correct fit of the trial components is tested, with special attention to the patellar tracking. The wound and bony surfaces are thoroughly irrigated with saline to remove debris and prepare the bone surface that will be in contact with the cement. Cement restrainers are placed on the femoral and tibial canals, and cement is applied to the canals and cut surfaces to receive the definitive implants. The hinge is placed and a polyethylene anti-dislocation device is inserted. After the polyethylene is locked, jump distance (the height of the translation that can happen between the femoral and tibial components of the hinge) no longer occurs, which makes it impossible to dislocate the implant.

A drain is used, which is maintained for a maximum of 48 h. The wound is closed by layers, in a conventional manner. Immediate ambulation is authorized, with partial weight-bearing soon after surgery and progressing to full weight-bearing according to the evolution of each patient.

Results

Nine surgeries were performed using the Endo-Model® implant: six primary and three revisions (Figs. 2 and 3). The indications were severe instability in six (66.7%) cases, and infection in three (33.3%) cases. Epidemiological data are described in Table 1. The mean age was 67.3 years (55–83). The mean follow-up was 12 months.

An improvement was observed in the Knee Society Score (KSS) and in all parameters of the Knee injury and Osteoarthritis Outcome Score (KOOS) when comparing the preoperative and postoperative periods. The patients' previous pain score was 8.7 in the preoperative period; in the postoperative period, the mean score was 2. Table 2 presents the clinical results of each patient individually and Table 3 compares the mean preoperative and postoperative scores.

One case of apraxia of the common fibular nerve was observed in the immediate postoperative period (Patient 1); foot dorsiflexion returned after four months of follow-up.

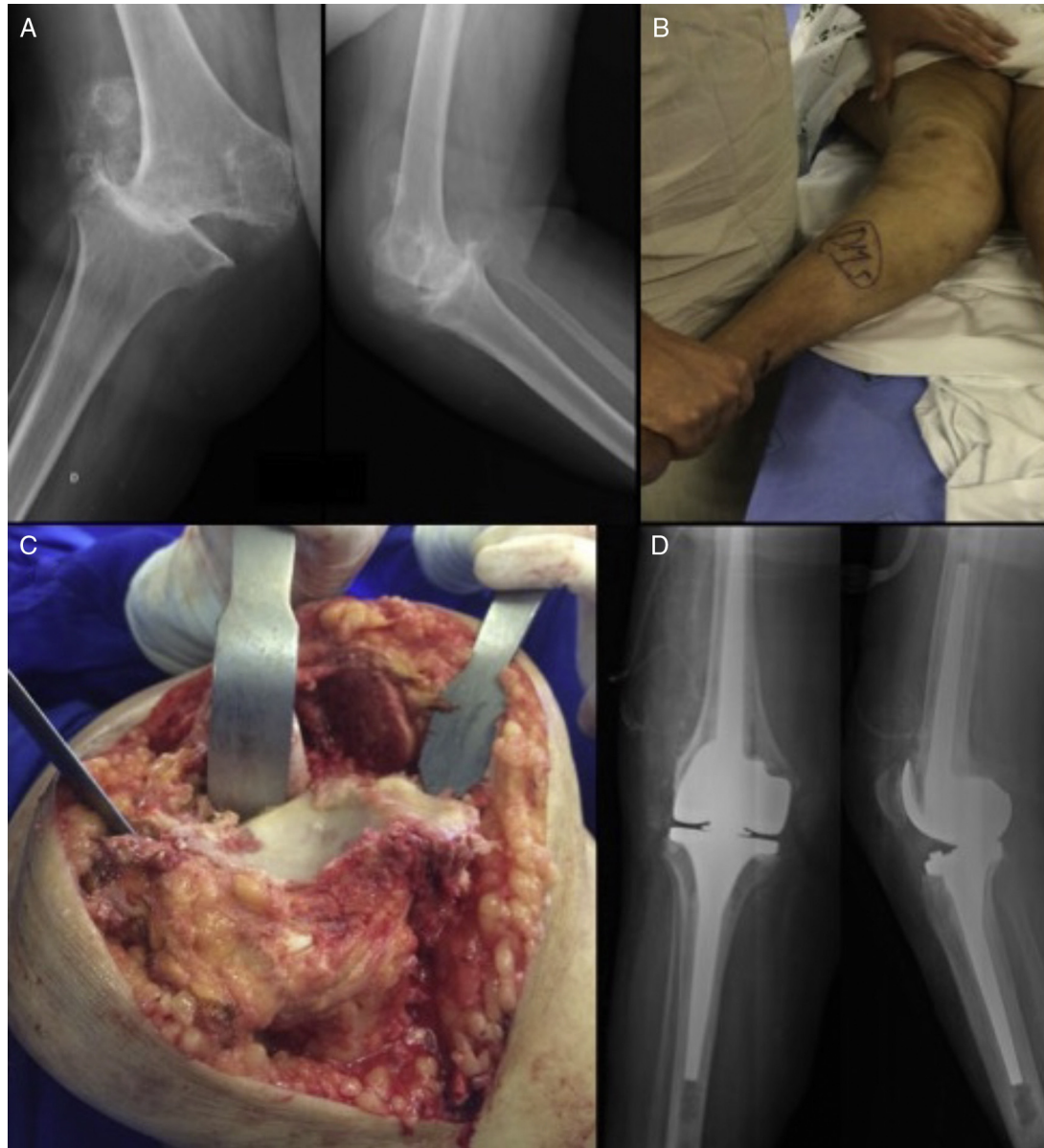


Fig. 2 – (A) Preoperative radiographs showing severe instability, with total insufficiency of the medial collateral ligament, and important lateral femoral and tibial failure; (B) clinical assessment of severe instability; (C) intraoperative image of severe tibial failure; (D) postoperative radiographs.

Discussion

The use of constrained hinge implants in TKA should be restricted to selected primary or revision cases, due to the inherent disadvantages of this type of prosthesis,⁷ including increased stress transmission to the bone-prosthesis interface, need for long nails for fixation, and need for bone resection greater than usual for non-constrained implants.^{2,4,5} However, this type of implant is a valuable surgical option for cases of severe instability with ligament insufficiency, bone destruction of ligament insertions, fixed deformities, or asymmetry in the areas of flexion and extension that hinder proper balance.^{2,7,9} The rotating-hinge design is desired,

since it decreases the stress on the fixation and allows a more physiological movement of the knee.^{4,6}

The results of the use of constrained rotational-hinge implants are not uniform in the literature, including series with excellent results and others with high complication rates.

Petrou et al.¹⁰ described 100 cases of primary TKA using the Endo-Model[®] implant, with a 15-year survival rate of 96.1% and excellent or good results in 91% of the cases. Also showing good postoperative clinical results, Bistolfi et al.¹¹ reported 98 cases of primary TKA, with 75% of implant survival at 15 years, despite a higher complication rate. Using the same implant only in cases of primary arthroplasty with extreme instability, Yang et al.¹² included 50 cases and observed a rate of 14% of postoperative infections in need of revision. In a

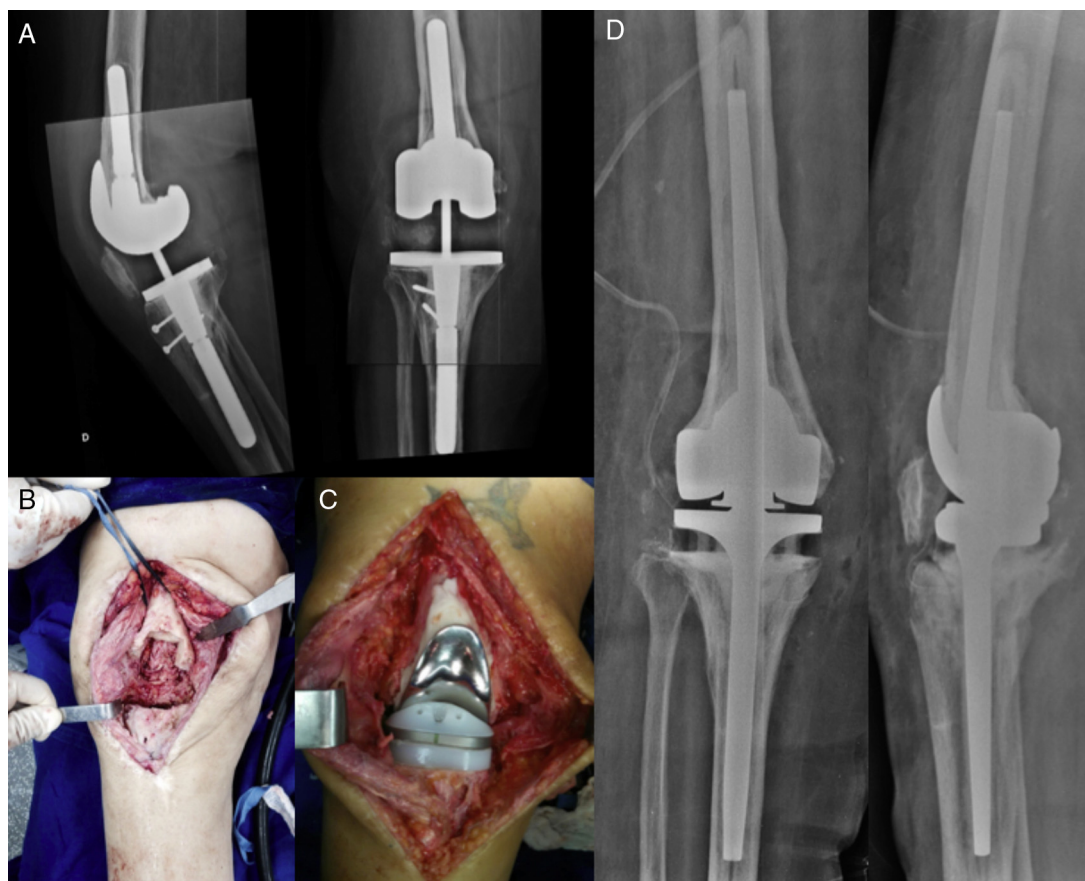


Fig. 3 – (A) Preoperative radiographs of a patient with unstable revision prosthesis; (B) intraoperative image with bone gap and collateral insufficiency, with grossly enlarged extension gap; (C) intraoperative image after definitive implant was cemented; (D) postoperative radiographs.

Table 1 – Epidemiological data of patients who underwent knee arthroplasty with hinged implant.

Patients	Age	Gender	Comorbidities		Indication	
1	69	F	Hypertension	Dyslipidemia	Varus 20°	
2	55	F	Rheumatoid arthritis		TKA revision after infection	
3	72	F	Hypertension	Dyslipidemia	TKA revision after infection	
4	60	M	Hypertension	Gouty arthritis	Varus 30°	
5	68	M	No comorbidities		Varus 25°	
6	55	F	Hypertension		Valgus 20°	
7	79	F	Hypertension	Cardiac arrhythmia	Valgus 40°	
8	65	F	Hypertension		Recurvatum 20°	
9	83	F	Hypertension	Coronary disease	Obesity	TKA revision after infection

more extensive series, Gehrke et al.⁷ presented a series of 238 primary TKA, with 90% total survival rate in 13 years; in patients over 60 years, this rate was 94%, versus only 77% in patients under 60 years.

Differences were also observed in the series in which this implant was used as a revision material. Sanguineti et al.¹³ reported 20 cases with a five-year follow-up, observing only two complications in the period: implant dislocation and deep infection. Zahar et al.⁸ described 70 cases of revision at one time with 93% infection control at ten years and 75% survival rate without reoperations in the period. In turn, Guenoun et al.¹⁴ reported 85 cases, 52 of primary TKA and 33 of revision TKA, with a high complication rate (28%), including nine

infections, four cases of patellar complications, and three aseptic loosening, with 89% of implant survival in three years.

Studies that used different constrained implants other than the Endo-Model[®] also presented diverging results and a high complication rate when compared with that of non-constrained implants. Vaquero-Hernández et al.¹⁵ assessed the results of 26 constrained prostheses, only in primary cases with ligament instability, and presented satisfactory functional results, but with a high complication rate (30%) and a 68% five-year survival rate. This result was quite similar to that of Pour et al.⁴ in a series of 33 cases using constrained implants in primary and revision procedures; despite the satisfactory results, these authors observed a 68.2% five-year survival rate.

Table 2 – Preoperative and postoperative functional scores of the evaluated patients.

Patients	1		2		3		4		5		6		7		8		9	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
KOOS																		
Pain	32.2	94.4	27.8	80.6	30.6	80.6	44.4	77.8	43	91.7	36.1	77.8	33.3	91.7	41.7	82.1	22.2	97.2
Symptoms	25	92.9	28.6	72.1	21.5	71.4	32.1	82.4	42.9	92.8	28.6	82.1	32.1	92.9	35.7	91.7	39.3	92.9
DLA	41.2	92.5	35.3	81.2	25	44.1	39.71	57.4	27.9	77.9	42.7	73.5	29.4	89.7	41.2	77.9	30.9	83.8
Sports	0	40	0	85	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quality	25	87.5	0	84	0	18.7	0	62.5	18.7	56.3	0	75	0	75.0	12.5	81.3	0	93.8
Total	28	86.3	25	88	22	51.2	29.8	61	25	72.0	25	72.1	31	61	32.7	72.6	23.8	79.2
KSS																		
Objective	38	94	50	100	45	81	19	88	30	94	26	65	15	97	25	94	8	95
Subjective	40	100	35	65	5	-10	20	20	10	40	35	65	20	85	35	70	-20	55
VAS	9	0	10	0	9	5	8	5	8	0	7	0	7	3	10	5	10	0

DLA, daily life activity; VAS, visual analog pain scale; KOOS, Knee injury and Osteoarthritis Outcome Score; KSS, Knee Society Score.

Table 3 – Mean preoperative and postoperative scores.

Patients	Preoperative	Postoperative	p-value
KOOS			
Pain	35.4 (±6.25)	86.13 (±7.3)	<0.001
Symptoms	31.8 (±6.8)	85.7 (±9.1)	<0.001
DLA	34.8 (±6.7)	75.3 (±15.5)	<0.001
Sports	0	13.9 (±29.8)	0.181
Quality	6.3 (±9.9)	70.5 (±22.7)	<0.001
Total	26.9 (±3.7)	72.9 (±11.9)	<0.001
KSS			
Objective	28.4 (±13.9)	89.8 (±10.8)	<0.001
Subjective	20.0 (±19.4)	54.4 (±33.6)	0.17
VAS	8.7 (±1.2)	2.0 (±2.5)	<0.001

DLA, daily life activity; VAS, visual analog pain scale; KOOS, Knee injury and Osteoarthritis Outcome Score; KSS, Knee Society Score.

Bistolfi et al.¹⁶ also included 33 exclusive revision patients; almost half of the cases presented postoperative complications, and three required a new revision. In a larger series, with 69 knees, Springer et al.⁵ presented a complication rate of 49%. Both studies recommend the use of this type of implant due to the lack of options in more severe cases, but suggest that, due to the high rate of complications, it should be performed in patients with less daily life demands and as a last resort salvage procedure.

Neumann et al.¹⁷ and Kowalczewski et al.¹⁸ reported smaller series, with 24 and 12 patients, respectively, but with more satisfactory results. Both had a minimum number of complications and good functional results, although they presented different indications: the first only performed revision surgeries and the second, only primary surgeries in patients with severe deformities.

The present authors believe that the disparity in results found in the literature originates from the variation of the populations in these series, all involving complex cases with difficult uniformity; it is difficult to quantify the initial degree of severity of each of the evaluated patients.

In the present series, short-term results demonstrated the possibility of performing this type of procedure with

satisfactory clinical results in high-complexity cases. The implant proved to be a solution for cases of severe instability, massive bone loss, and infection with extensive debridement, which would not have a satisfactory solution with the conventional non-constrained implants available in Brazil.

Regarding previously available constrained implants, a single recent case series in Brazil reported a complication rate of around 70%,⁹ considering major and minor complications, which discourages its use, even as the only option available to date for solving these cases. Therefore, the authors believe that the present study demonstrates the possibility of better results for this subgroup of patients with the present implant, when compared with implants previously available in Brazil. In general, it was observed that studies that used Endo-Model[®] implants presented lower complication rates when compared with other types of implants, but because it is still a recent implant, it should be observed with caution and requires more follow-up time.

The current study has some limitations. It is a description of cases, with a reduced number of patients from a single institution and with a short follow-up period, which does not allow conclusions about the definitive result of this procedure to be drawn. Aware of these limitations, however, the present study describes the success with the initial use of this model of implant in Brazil, being an option for many surgeons who treat these very severe cases of primary and revision TKA. The results of the use of this implant in other countries are known, and considered successful.

Conclusion

The use of a rotational-hinge implant in TKA is a new option in Brazil for complex cases with severe instability, with satisfactory initial results.

Conflicts of interest

The authors declare to have no conflicts of interest.

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