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Complications after trochanteric fractures

A comparison between Ender and nail-plate osteosynthesis

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Three hundred and forty-one trochanteric femoral fractures operated with intramedullary nailing (Ender) or nail-plate osteosynthesis (McLaughlin) were followed up for 4 months and reoperations were recorded at 18 months. Both methods had an unacceptably high frequency of complications, radiographically in one third and reoperations in one tenth of the total material. The greatest number of operative technical problems was encountered in the Ender group. The 4-month radiographic follow-up showed more complications in unstable than in stable fractures for both methods. In stable fractures, the Ender group had more radiographic complications. There was a slightly better walking capacity at 4 months and fewer reoperations at 18 months in the McLaughlin group.

Key words: fracture fixation, intramedullary; fracture fixation, internal; fractures, complications; trochanteric femoral fractures

Thornton (1937) was the first to describe a nail-plate system for internal fixation of trochanteric fractures, and this was further developed by McLaughlin (1947). Lezius (1950) was the first to introduce intramedullary nails for fractures of the proximal femur and this method was further developed by Küntscher (1966) and Ender & Simon-Weidner (1970). Elastic intramedullary nails have been increasingly used since then. Both methods have several technical pitfalls (Dimon & Hughston 1967, Högh et al. 1981, Jensen & Michaelsen 1975, Jensen et al. 1980, Wynn-Jones et al. 1977).

The purpose of this investigation was to compare two groups operated with intramedullary nailing or nail-plate osteosynthesis at four hospitals regarding ADL-function after 2 weeks and 4 months. Radiologic complications within 4 months and reoperations within 18 months were registered for both groups.

Material and methods

Three hundred and sixty-eight patients with 376 trochanteric femoral fractures admitted to the Department of Orthopaedic Surgery in Lund, Landskrona, Ystad and Trelleborg from March 1976 to March 1979 were studied. The Ender nail was used in 226 fractures and the nail-plate method according to McLaughlin in 115 fractures. For 30 patients, the radiographs were missing or inadequate. Three patients died before the operation, one patient was operated with a hemiarthroplasty and one patient was treated in traction.

Seventy-nine of the fractures classified were treated from March 1976 to March 1977 in the three local hospitals in Malmöhus county (Landskrona, Ystad and Trelleborg). The Ender technique was the only method used at these three hospitals. The McLaughlin technique was the standard operation in Lund in the last decade and the only method used until March 1977 (115 fractures). The Ender technique was then slowly introduced and was the method of choice from December 1977 (147 fractures). The overall policy at the four hospitals has been to allow immediate weight-bearing. The material and epidemiology have been described in detail recently (Wallöe et al. 1983).

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Radiographic follow-up

Radiograms of the hip were taken in the anterior-posterior and lateral projection prior to surgery in all patients. A new radiogram was done after surgery in the operating room and repeated 1 week and 4 months postoperatively. The fractures were classified according to Evans regarding stability (Table 1).

Patients with radiographically suspected delayed union at 4 months were further followed.

Nail position in the femoral head and perforation of the femoral head, nail insertion in the femoral condyle and sliding, fractures occurring during surgery, fracture displacement and mechanical failures were specially studied.

Technical performance

In order to evaluate whether technical skill could influence the radiologic results, the three local hospitals, where two senior surgeons operated on almost all the cases, have been compared with the university hospital, where training necessitates a rotation system which may give less experience. In Lund, surgeons with less or more than 4 year's experience or who have operated on less or more than 10 patients have been compared.

Clinical follow-up

For patients operated in Lund, the following parameters were studied 2 weeks and 4 months postoperatively: dressing, toileting, pain when walking and walking ability. The mobility and ADL scoring system according to Ceder (1980) was used.

Reoperations during the first 18 months were registered (for Lund) and classified as minor (removal of the osteosynthetic material and reinsertion of the Ender nails) or major (all other operations).

Table 1. Classification of 341 trochanteric fractures according to Evans

Type of fracture	McLaughlin (n=115)	Ender (n=226)
1 a	15%	16%
1 b	26%	29%
1 c	36%	33%
1 d	11%	12%
2	12%	10%

Results

The classification of 341 fractures according to Evans did not show any difference in distribution regarding stability between the Ender group and the nail-plate group (Table 1).

Tables 2–5 show the immediate postoperative nail position in the femoral head, the location of nail insertion and the peroperative distal femoral fractures which occurred. It could be concluded that less operative technical problems were encountered with the nail and plate than with the Ender nail. The difference in figures between the tables is due to the fact that in some of the patients radiograms of the knee were either missing or could not be evaluated.

At the 4-month radiologic follow-up, the nail and plate had perforated the femoral head in 6 per cent, all in unstable fractures (Chi square test $p < 0.05$). Varus displacement (a cervico-femoral angle of less than 110 degrees) occurred in 20 per cent, all in the unstable group ($p < 0.001$). Loosening of the bolt occurred in 14 per cent, 13 out of 14 in the unstable group ($p < 0.01$). Bending of the nail occurred in 3 per cent, and loosening of the plate in 1 per cent. There

Table 2. Initial nail position[1] in 115 fractures treated with McLaughlin nail-plate system

Type of fracture	Total	Unacceptable
Stable	47	10
Unstable	68	15
Total	115	25 (22%)

1. Distances from 10 mm to 30 mm between the end of the nail and the cartilage of the femoral head were considered acceptable.

Table 3. Initial nail position[1] in 226 fractures treated with Ender nails

Type of fracture	Total	Unacceptable
Stable	103	63
Unstable	123	71
Total	226	134 (59%)

1. Distances from 5 mm to 15 mm between the end of the nail and the cartilage of the femoral head were considered acceptable.

Table 4. Location of the nail insertion[1] in 207 fractures treated with Ender nails

Type of fracture	Total	Unacceptable
Stable	95	10
Unstable	112	21
Total	207	31 (15%)

1. The most concave place above the condyle was considered to be the most accurate insertion. If the insertion was more than ±20 mm from this place, it was considered unacceptable.

Table 5. Peroperative distal femoral fractures in 213 fractures treated with Ender nails

Type of fracture	Total	Flake[1] fractures	Supracondylar fractures
Stable	96	23	1
Unstable	117	36	0
Total	213	59 (28%)	1

1. Flake fractures were defined as fractures where the flake exceeds 20 mm.

was one fracture below the plate 3½ months after fracture.

With the Ender nail, the femoral head was perforated in 19 per cent, 27 out of 36 in the unstable fractures ($p < 0.001$). The varus displacement was 15 per cent, with 22 out of 28 in the unstable group ($p < 0.01$). Distal sliding of one or more of the nails (more than 20 mm) occurred in 17 per cent, 24 out of 32 in the unstable group ($p < 0.01$). If the radiographic complications are summarized regarding perforation, varus dislocation and distal sliding (Table 6), there were significantly more complications in the Ender group in the stable fractures ($p < 0.001$). If the complication of distal sliding is excluded, there were still significantly more complications for Ender nailing in the stable group. There was, however, no difference in the unstable fractures ($p > 0.05$). Both methods gave more complications in the unstable group (nail and plate $p < 0.01$, Ender nailing $p < 0.001$).

In the Ender group, no differences in radiographic complications in relation to technical skill were found between specialist and non-specialist (less than 4 years) or between the surgeons having done less than or more than ten Ender nailings. When the different types of hospital were compared, no differences were found.

Table 6. Radiographic comparison between McLaughlin and Ender osteosynthesis regarding complications in 289 fractures at 4-month follow-up

	McLaughlin		Ender	
	Total	Complications[1]	Total	Complications[2]
Stable	42	0	84	20
Unstable	60	24	103	55
	102	24 (24%)	187	75 (40%)

1. Perforation and/or varus displacement.
2. Perforation and/or varus displacement and/or distal sliding.

There were no differences regarding pain, dressing and/or toileting. A slightly better walking ability was found at 4 months in the nail-plate groups ($p < 0.05$) (Tables 7 and 8). Differences in figures between the tables are

Table 7. Walking capacity in 58/115 fractures (McLaughlin): prefracture and at 4 months[1]

		Prefacture				
		0	1	2	3	4
Four months	0	7	0	0	0	0
	1	19	6	0	0	0
	2	5	4	4	0	0
	3	1	4	0	0	0
	4	1	0	0	0	7

0: Walking without aids.
1: Walking with crutches.
2: Walking with quatraped.
3: Walking with rollator.
4: Unable to walk.

Table 8. Walking capacity in 105/147 fractures (Ender), prefracture and at 4 months[1]

		Prefacture				
		0	1	2	3	4
Four months	0	10	0	0	0	0
	1	26	13	0	0	0
	2	10	10	2	0	0
	3	2	5	2	4	0
	4	7	4	3	3	4

1. For explanation, see Table 7.

Table 9. Comparison between nail and plate (McLaughlin) and Ender nailing regarding reoperations in 262 fractures at 18 months

	McLaughlin			Ender		
	Total	Reoperation		Total	Reoperation	
		Minor	Major		Minor	Major
Stable	47	3	0	62	5	2
Unstable	68	7	1	85	13	5
Total	115	10	1	147	18	7

due to missing information about walking capacity in some of the patients, either before operation or at the 4-month follow-up.

There was no difference in the reoperation frequency between nail and plate (10 per cent) and the Ender nail (17 per cent), or between major and minor surgical intervention at 18 months (Table 9).

Discussion

Life expectancy and age-related fractures have increased in the Western countries during the last decade. However, optimal postoperative rehabilitation and integration of primary care units will make it possible for most patients with hip fractures to return to their preoperative level of daily activities (Ceder 1980).

A comparison of the same age group of patients with femoral neck fractures operated with an atraumatic method showed that these were easier to rehabilitate than patients with trochanteric femoral fractures (Jacobsen et al. 1983). To reduce the operative trauma, Ender nailing for trochanteric fractures was started in many countries during the seventies. However, several technical pitfalls gradually appeared (Wynn-Jones et al. 1977, Jensen & Sonne-Holm 1980, Lund et al. 1981). In the present study it was shown that the nail position in one quarter of the nail and plate group and half of the Ender group had been inserted in a position that was not optimal (Tables 2 and 3). Analysis of complications must take stability into account (Wallöe et al. 1983), as the number of unstable fractures will significantly influence the operative results (Tables 1–6). In this study there were significantly more radiographic complications in the unstable group. The figures are in accordance with those of Chapman et al. (1981) but lower than those given by Jensen & Sonne-Holm (1980). The Ender nails gave more radiographic complications than the nail and plate in the stable group and this has not been reported earlier. It could be explained by the fact that the Ender nails tended to dislocate the proximal fragment during surgery and also to give a less stable fixation. In an earlier study, it was shown that the Ender nail gave more rotational deformity than the nail and plate. This could not be compensated for by use of a prebent, anteverted Ender nail (Herrlin et al. 1983).

Technical skill, defined as more than 4 years experience of orthopaedic surgery or having performed at least 10 Ender nailing operations, did not influence the results. Postoperative rehabilitation and return to preoperative activity within 4 months did not differ between the two groups. Walking capacity (Tables 7 and 8) at 4 months was slightly better for the nail and plate group, reflecting the frequent distal sliding of the Ender nail with accompanying knee problems. There was a non-significant but slightly greater number of reoperations in the Ender group (17 per cent) compared with the nail and plate group (10 per cent) at 18 months (Table 9).

As reported by several authors (Alffram 1961, Högh et al. 1981, Lund et al. 1981), functional end results are often better than would be expected from looking at the radiographic complications. The Ender nail, however, does not seem to have any technical advantages over nail and plate fixation, and both devices showed an unacceptably high frequency of complications.

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References

Alffram, P. A. (1961) Om funktion efter trochantär femurfraktur. *Nord. Med.* **66**, 1153

Ceder, L. (1980) *Hip fracture in the elderly.* Thesis, Lund.

Chapman, M. W., Bowman, W. E., Csongradi, J. J., Day, L. J., Trafton, P. G. & Bovill, E. G. (1981) The use of Ender's pins in extracapsular fractures of the hip. *J. Bone Joint Surg.* **63**-A, 14–28.

Dimon, J. H. & Hughston, J. C. (1967) Unstable trochanteric fractures of the hip. *J. Bone Joint Surg.* **49**-A, 440–450.

Ender, J. & Simon-Weidner, R. (1970) Die Fixierung der trochantären Brücke mit runden elastischen Condylennägeln. *Acta Chir. Austr.* **1**, 40–42.

Herrlin, K., Egund, N., Andersson, S. & Wallöe, A. (1982) Anteversion measurement in trochanteric fractures of the femur. *Acta Radiol. Diagn.* **23**, 409–413.

Högh, J., Lund, B. & Lucht, U. (1981) Trochanteric and subtrochanteric fractures. *Acta Orthop. Scand.* **52**, 639–643.

Jakobsson, B., Andersson, L., Jarnlo, G.-B. & Stenström, A. (1983) Postoperative nursing care and rehabilitation in patients with hip fracture. In preparation.

Jensen, J. S. & Michaelsen, M. (1975: Trochanteric femoral fractures treated with McLaughlin osteosynthesis. *Acta Orthop. Scand.* **46**, 795–803.

Jensen, J. S. & Sonne-Holm, S. (1980) Critical analysis of Ender nailing in the treatment of trochanteric fractures. *Acta Orthop. Scand.* **51**, 817–825.

Jensen, J. S., Sonne-Holm, S. & Töndevold, E. (1980) Unstable trochanteric fractures. A comparative analysis of four methods of internal fixation. *Acta Orthop. Scand.* **51**, 949–962.

Küntscher, G. (1966) Zur operativen Behandlung der pertrochantären Frakturen. *Zbl. Chir.* **91**, 281–285.

Lezius, A. (1950) Intramedullary nailing of intertrochanteric and subtrochanteric fractures with curved nail. *J. Int. Coll. Surg.* **5**, 569–572.

Lund, B., Högh, J. & Lucht, U. (1981) Trochanteric and subtrochanteric fractures. *Acta Orthop. Scand.* **52**, 645–648.

McLaughlin, W. S. (1947) An adjustable internal fixation element for the hip. *Am. J. Surg.* **73**, 150–161.

Thornton, L. (1937) The treatment of trochanteric fractures of the femur. Two new methods. *Piedmont Hosp. Bull.* **10**, 21–35.

Wallöe, A., Andersson, S., Herrlin, K. & Lidgren, L. (1983) Incidence and stability of trochanteric femoral fractures. *Acta Orthop. Scand.* **54**, 622–626.

Wynn-Jones, C., Morris, J., Hirschowitz, B., Hart, G. M., Shea, J. & Arden, G. P. (1977) A comparison of the treatment of trochanteric fractures of the femur by internal fixation with a nail and plate and the Ender technique. *Injury* **9**, 35–42.