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Minimally invasive dynamic hip screw for intertrochanteric fractures: comparison with conventional method and surgical tips

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ABSTRACT

Background: Intertrochantric fractures of the proximal femur are one of the most common injuries of the elderly. Prolonged duration and peroperative blood loss in this elderly frail population is one of the major problems in using the DHS. We performed minimally invasive DHS (MIDHS) implantation for such patients and compared results with conventional technique, hypothesising better perioperative outcomes.
Methods: We operated upon 30 cases as the case group from June 2013 to August 2016 with this technique. Patients older than 60 years of age with BMI less than 25 with stable AO type fractures which were easily reducible without sag of the distal fragment were included. In a control group 30 patients who had their hip fracture fixed with a DHS placed through the conventional approach were included. These groups were matched for sex, age, ASA grade and fracture type according to the AO classification. All surgeries were performed within 3 weeks of injury. We studied the patients in terms of time taken for surgery, peroperative blood loss, postoperative pain scores, need for analgesics and improvement in postoperative mobilization and rehabilitation by HHS.
Results: Blood loss, duration of surgery and average pain score were significantly lower ($p<0.0001$) for MIDHS group due to a smaller incision and less muscle dissection. The HHS was also significantly better at 10 days in the MIDHS group.
Conclusions: Minimally invasive DHS is a simple and effective technique for fixation of intertrochantric fractures, especially in elderly, with reduced operative time, blood loss and postoperative pain scores leading to a more effective postoperative rehabilitation.

Keywords: Intertrochanteric fracture, DHS, MIDHS, Stable fracture, BMI

INTRODUCTION

Intertrochanteric fracture is on a rise world over, due to combined effect of increased longevity and osteoporosis.[1,2] These occur as a result of trivial fall or other modes of low velocity trauma. Other factors contributing to the same are poor vision, lack of coordination and balance. With an increase in longevity there is associated rise in preexisting morbidity in this elderly frail population prone for intertrochanteric fractures, making it challenging for orthopaedic surgeons to manage these patients.[3] Hence any strategy to lessen the intra and perioperative morbidity should be welcome.

Non operative treatment for these fractures was associated with a considerable increase in morbidity like hypostatic pneumonitis, deep venous thrombosis and bedsores due to need of traction in bed for up to 3 months and hence largely been abandoned. Operative treatment has risks inherent to the surgery, anaesthesia and various medical co-morbidities associated. Longer operative

times and preoperative bleeding, further compound the already high risk associated with surgery.

Operative fixation of these fractures with a sliding hip screw and side plate construct (Dynamic Hip Screw) is still the gold standard especially for stable fractures, despite the development of newer implants like cephalomedullary nail (proximal femoral nail, Gamma nail etc.) due to adequate collapse and compression at fracture site, ease of technical application, established long term results and familiarity amongst most practicing surgeons.[4-8]

We believe that with high medical complication and risks of anaesthesia and operation in this already frail population with medical co-morbidities, any attempt to reduce the peroperative time and bleeding can significantly reduce the postoperative morbidity. Thus the purpose of this study was to describe the tips and tricks for performing a minimally invasive DHS to achieve the same in an easy and accurate way. We also compared the perioperative parameters with a conventional DHS group.

METHODS

We conducted a case control study to compare the perioperative results of MIDHS and the conventional DHS. We operated upon 30 cases of AO Type 31-A1 and 31-A2 fractures from June 2013 to August 2016 with minimally invasive technique (Group A) and compared this group with 30 patients operated with the conventional technique (Group B). Each patient within the minimally invasive DHS group was matched, according to their sex, age, ASA grade and fracture type according to the AO classification, to a patient who has had their hip fracture fixed with a DHS placed through the conventional approach. An ethical committee clearance was obtained for the study. All the patients gave their consent for academic publication of results before the surgery. All cases were operated by a team of two surgeons under spinal anaesthesia. Implant used for all procedures was the same DHS assembly (Kaushik surgicals) available free of cost through hospital supply. The selection criteria were:

1. Only patients with greater than 60 years of age who were fit for anaesthesia.
2. Patients with BMI less than 25.
3. AO type A-1 and A-2 fractures which are easily reducible and without sagging of the distal fragment.
4. Surgeries performed within 3 weeks of injury.

Criteria 1 and 2 when followed made the procedure easy to perform since thinner and older patients have less fat, muscle mass and a lax tensor fascia lata (TFL). With these selection criteria any orthopaedic surgeon can perform the procedure with ease and once confident, can extend the indications to younger and obese patients and in more complex fractures.

In group A, the patients were put on a fracture table and reduction achieved with traction and appropriate rotation before cleaning and draping the patient. Before giving the incision, the greater trochanter was palpated and all landmarks marked (Figure 1). A guide wire was placed anteriorly on the skin along the neck from the expected entry point (2.5 cm below the flare of greater trochanter) to the head of femur and a C-arm image was taken. The point where it leaves the lateral aspect of thigh was marked on the skin. It is important to note that the skin incision should always start below this point for about an inch. If need be, it can be later increased for another 1-2 cm. A skin incision nearly 3 cm was made followed by incising the TFL. Vastus lateralis muscle was bluntly split with an artery forceps. Once the bone was reached, retractors were placed and periosteum cut longitudinally. A small but sharp periosteum elevator was used to strip periosteum and muscles from the bone just deep to the incision and downwards along the shaft for a distance equal to the length of the plate (almost always a 4 hole plate is used). The incision is not big enough for the 135 degree angle guide to be passed to the bone. Hence the angle guide was placed on the skin anterior to the thigh or on the lateral aspect keeping it exactly parallel to the shaft when confirmed with the C-arm (Figure 2).The guide wire was passed into the head through the neck from the conventional entry point maintaining the 135 degree angle as directed by the angle guide (Figure 2). Deep narrow Langenback retractors were used to protect soft tissues and TFL from injury while passing the guide wire. An indirect measuring gauge was used to measure the length of screw to be used. The exact length is decided by accounting for 5 mm for compression along the fracture site and the tip apex distance. Serial reaming was done using the triple reamer, up to the selected length (Figure 3). Usually the incision is only big enough for the triple reamer to be passed. Protection of the skin is most important and can be protected from abrasion by the reamer by simple eversion. The reaming was done at a slow rpm to prevent much damage to the muscle mass. The canal was then tapped and an appropriate length Richard screw was put using a T-handle attachment.

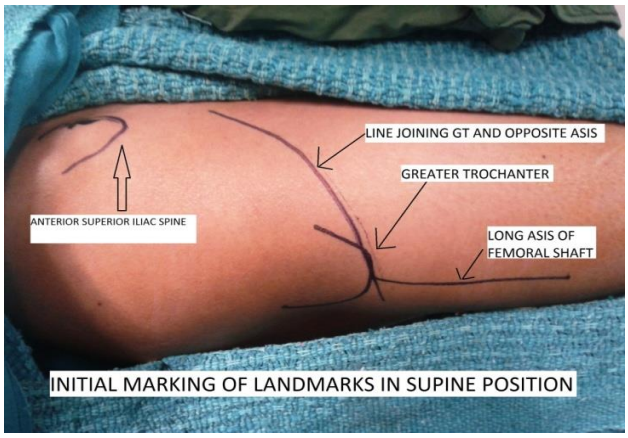

Figure 1: Skin marking prior to surgery.

It is very important to note that at the end of the screw insertion the T-handle should be left in an exact horizontal position in which the plate barrel can slide upon the screw with proper lateral orientation on femoral shaft. Some manufacturers have a smooth outer surface of the Richard screw and likewise smooth inner surface of the barrel, which is easy to slide into; others have a slotted surface. In the second type of designs lot of precision is needed to position the Richard screw in the bone, as even 5-10 degrees of rotation mismatch may make it impossible for the surgeon to engage the barrel into the screw with the small exposure. In fact this may become the most difficult step to perform, especially for beginners. To engage the barrel in the Richard screw the distal end of the plate was first slid along the shaft from the incision (Figure 4). Following this a stab incision was given at point where the distal most screw was expected to be put in the plate, the point confirmed by the C-arm. The muscle was split with a long artery forceps and the forceps was placed between the plate and the bone. This artery was mainly used to hook in the last plate hole and pull the side plate laterally so that it became parallel to the femoral shaft and barrel was in direct contact of triple reamer hole and in appropriate alignment with the lateral end of the Richard screw. At this point a Teflon impactor was placed in the proximal most hole of the plate and lightly hammered and more often than not the barrel gets engaged in the screw. Alternately if enough space was created to put the index finger and the thumb in the wound, the barrel may be manipulated into the screw with some pressure along the direction of the screw and lightly hammered in the end for final impaction. Subsequently the screws in the plate were put. Up to three of the proximal screws may be put from the proximal incision, but this is only feasible in patients having lax skin and muscles, hence the importance of the selection criteria. If putting the third screw is not possible from the main incision then it can be put percutaneously from a stab incision. Lastly the distal most screw in the four hole plate was put from the stab incision previously made.

The dressing was routinely changed on second postop day, suction drain removed and the patient discharged on oral antibiotics on fourth postop day depending upon condition. Patients were taught static quadriceps exercise and knee range of motion exercises and mobilized with toe touch weight bearing with crutches as tolerated. Sutures were removed on tenth postop day.

In group B patients the conventional technique familiar to all orthopaedic surgeons was followed. A 10 cm incision is given and the surgery is conducted. In postoperative period all patients underwent the same rehabilitation protocol as the other group. These patients were discharged on fifth or sixth postoperative day only after ruling out any wound complications and maintaining postoperative haemoglobin above 10 gm%. Patients were recalled for suture removal at 2 weeks. All patients in both groups having osteoporosis Grade 2 and 3 according to Singh's index were infused injection Zolidronic acid on the third day after surgery. Follow-up X-rays were done routinely at 6 weeks and 12 weeks in both the groups. Further X-rays were done only if required.

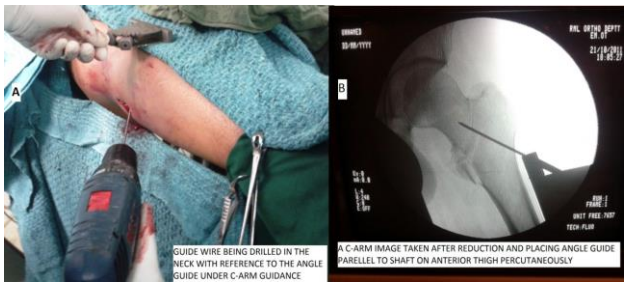

Figure 2: Positioning of angle guide on anterior femoral shaft and guide wire passage A) surgical picture B) C-arm image.

Figure 3: Reaming through the small incision with soft tissue protection.

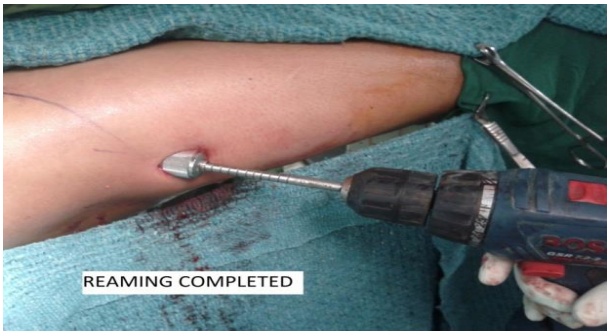

Figure 4: Incision size almost as big as the size of triple reamer.

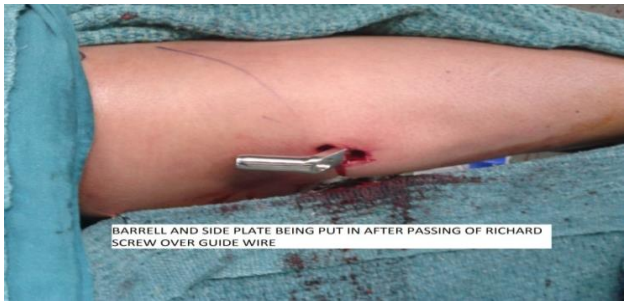

Figure 5: Passage of plate by sliding along femoral shaft through primary incision.

To compare statistically significant difference between means of the two groups of DHS, the t-test for independent samples was performed in SPSS, with p <0.5 considered as significant. The 'DHS type' was selected as the grouping variable with the group categories: A and B. A null hypothesis was formed that there is no significant difference between the two groups in terms of Harris Hip Score (HHS) at 10 days and 6 weeks, average blood loss, average pain score and duration of surgery and hospital stay.

RESULTS

We studied these groups in terms of time taken for surgery, peroperative blood loss, postoperative pain scores and need for analgesics, postoperative mobilization and rehabilitation and finally the time for union and compared the results amongst the two groups. We also evaluated the functional level of the patient with the Harris Hip Scores taken at 10 days and 6 weeks postoperatively (Table 1).

Table 1: Perioperative results of MIDHS and conventional DHS groups.

	MIDHS		CONV DHS		
	Mean value	Std dev.	Mean value	Std dev.	Significance (P)
Surgical duration	53.6 min	13.66	77.6 min	16.19	<0.0001
Intra op blood loss	47.58 ml	23.07	142.67 ml	57.77	<0.0001
Mean pain score	3.77	0.49	5.70	0.66	<0.0001
HHS at day 10	58.86	7.14	55.0	7.61	0.047
HHS at 6 weeks	85.90	4.28	84.03	3.93	0.084
Duration of hospital stay	3.2 day	0.43	7.7 day	1.2	<0.0001

The average time of surgery was 53.6 minutes (ranging from 42 minutes to 69 minutes) in group A calculated from the skin incision to the closure of skin (skin to skin time) as compared to 77.6 minutes (ranging from 66 to 92 minutes) in group B. The reduction in surgical time with MIDHS was statistically significant with p<0.0001. In group B although time was saved in seating the plate more time was spent in exposing the bone, achieving haemostasis and later suturing the wound in layers. In group A patients, peroperative blood loss was average 47.58 ml measured by the gauze soaked. Also the preoperative and postoperative haemoglobin were assessed and there was no significant difference in the two values with a mean drop of 0.4 gm% and none of patients required any blood transfusions. On the contrary, in group B the average blood loss was 142.67 ml (70 ml to 250 ml). Also there was on an average drop of 1.1 gm% in the postoperative haemoglobin level. This decrease in blood loss with MIDHS was also statistically significant (p<0.0001).

In group A patients postoperative pain score was average 5.63 on first postop day and reduced to average 1.9 on third postop day. Patients usually refused oral analgesics on third postop day. In contrast in group B, average pain score was 7.4 on first postop day which reduced to 4.0 on third post-operative day. Also they persistently needed analgesics (injectable till 3 days followed by oral) till the time of suture removal. Group A patients were observed to respond better in the immediate postop period to physiotherapy exercises like knee bending and toe touch weight bearing walking with support before they were discharged. All patients achieved a knee range of motion of 90 degrees prior to discharge. In contrast, group B patients experienced difficulty in knee bending and walking with crutches. They could achieve full range of motion till seventh postop day.

Time of hospital stay was on an average 3.2 days in group A, significantly lower (p<0.0001) than 7.7 days in group B. There were no infections or wound complications in group A and 2 superficial infections in group B which were managed by dressings and antibiotics according to sensitivity. Both wounds healed uneventfully.

The average Harris hip score (HHS) was 85.9 in group A patients and 84.03 in group B patients at 6 weeks, and was 58.86 and 55 respectively at 10 days postoperatively. All patients had adequate union at 12 weeks in both groups. The difference in HHS was statistically significant at 10 days (p=0.047) but not at 6 weeks (p=0.084).

DISCUSSION

Minimally invasive trauma and joint surgeries have always been fancied by surgeons across all disciplines. In orthopaedics MIS (minimally invasive surgery) have been extensively used for the management of distal tibia fractures, humerus fractures as bridged locking plates, for other long bone fractures and more recently for pedicle screw fixation in spine fractures. These procedures may be technically demanding, at least to begin with and the surgical time and expertise improves with experience. All these procedures have proposed advantage in rehabilitation and decreased pain at least in the immediate postoperative period when compared with the more invasive, traditional procedures. Similar is the case with the minimally invasive DHS (MIDHS).

The technique is easy to learn for even younger orthopaedic surgeons who are well versed with the conventional technique. All beginners for the technique should restrict them to the above mentioned selection

criteria and should extend the same to severe AO types and younger patients thereafter.

Many authors have described the technique with a two hole plate which has proven to be biomechanically equally stable.[9-11] As a matter of surgeon's choice we did not use a shorter plate in any case to be confident regarding postoperative mobilization of the patient. Also many of our patients had Singh's index type 3 and 2 osteoporosis in whom fixation with a two hole plate was deemed to be risky in terms of stability. In fact some surgeons have used a locking DHS in these patients to enhance stability, though we have no experience in using this implant.

The benefits of the technique with respect to preoperative bleeding, requirement of blood transfusion, postoperative pain and early mobilization are discussed by various authors as well, but the finer details of the technique when understood and implemented, can make the procedure a valuable adjunct in the armoury of all trauma surgeons with maximum benefits.[12,13]

Our study shows that the difference between the two groups in terms of HHS at 10 days was statistically significant (p=0.047), favourable for MIDHS group due to less pain and better wound healing of smaller incisions leading to better mobilization and range of motion. This difference was not statistically significant (p =0.084) at 6 weeks as expected as by this time soft tissue healing is more or less complete also for the conventional group. However, the improvement in early HHS can have far reaching impact on early rehabilitation and mobilisation, thereby preventing complications like DVT and pneumonitis. Blood loss, duration of surgery and average pain score were also significantly lower (p <0.0001) for MIDHS group due to a smaller incision and less muscle dissection.

Ho et al compared the minimal invasive DHS with the conventional method.[12] They found that the duration of hospital stay and length of surgery were statistically favourable for minimally invasive group which was a similar finding in our study as well due to obvious reasons (p<0.0001 for both variables). The difference in the fall in Hb was not found to be statistically significant in their study. There were 2 superficial wound infections in the conventional group (4.54%) in their study which was similar to our study (6.67%).

In another prospective randomised study by Wong et al the MIDHS group had statistically significant lower fall of Hb level and rate of blood transfusion similar to our study.[13] Hospital stay was lower in MIDHS but not statistically significant, though it was significantly lower in our study (p<0.0001). HHS at 3 days was statistically higher in MIDHS but not at 3 months. Similarly in our study HHS at 10 days was statistically significant (p<0.05) but not at 6 weeks.

Various authors have described a MIDHS technique but not in a comparative controlled manner.[14-16] Also most of these authors have used a 2 or 3 hole DHS or have not standardised the length of plate in their study.

The use of intramedullary nails like PFN, Gamma nail is rapidly increasing, especially among the younger surgeons. The perceived benefits are a minimally invasive insertion, rapid surgery and better biomechanical stability.[17-21] However in the meta analysis by Parker and Handoll there was no statistical difference in the operative time, blood loss or radiation exposure in analysis of 3500 patients.[4] Infact there were more chances of intra and postoperative fractures, technical complications and reoperation rates associated with the nailing group. Song et al prospectively analyzed the systemic effect by comparing preoperative and postoperative values of CPK and CRP in intertrochantric fracture patients operated with DHS and Gamma Nail (Stryker, Kalamazoo, MI, USA).[22] Their results showed levels of CRP were statistically lower in DHS than in Gamma nail group on days 1 and 2 which shows that though the incision may be smaller or equal in Gamma nail group than DHS, the latter is systemically less invasive than the former, as CRP is widely accepted as a marker of systemic inflammation. This finding was most probably due to intramedullary reaming. Also the serum CPK levels were not lower in Gamma Nail group even with a smaller incision which may be due to muscle damage during reaming or muscle compression as speculated by the authors.

One of the limitations of our study is that radiological assessment of screw position was not done in both the groups. However, as all the fractures were stable type and had united within reasonable time without any complications this comparison seems less significant. We also didn't follow the patients for longer term as the primary aim was to establish the difference in perioperative outcomes of the two techniques.

CONCLUSION

Hence it can be easily concluded that the MIDHS is a simple and effective technique for fixation of intertrochantric fractures, especially in elderly, with advantages of reduced operative time, blood loss and postoperative pain scores leading to a more effective postoperative rehabilitation. Technical indications suggested by us are by no means absolute and can be widened with experience.

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Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Sterling R. Gender and Race/Ethnicity Differences in Hip Fracture Incidence, Morbidity, Mortality, and

Function. Clin Orthop Related Res. 2010;469(7):1913-8.
2. Riggs B, Melton L. The worldwide problem of osteoporosis: Insights afforded by epidemiology. Bone. 1995;17(5):505-11.
3. Kannus P, Parkkari J, Sievänen H, Heinonen A, Vuori I, Järvinen M. Epidemiology of hip fractures. Bone. 1996;18(1):57-63.
4. Parker MJ, Handoll HH. Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hipfractures in adults. Cochrane Database Syst Rev. 2008;16:CD000093.
5. Saudan M, Lübbeke A, Sadowski C, Riand N, Stern R, Hoffmeyer P. Pertrochanteric Fractures: Is There an Advantage to an Intramedullary Nail? J Orthop Trauma. 2002;16(6):386-93.
6. Bolhofner B, Russo P, Carmen B. Results of Intertrochanteric Femur Fractures Treated With a 135-Degree Sliding Screw With a Two-Hole Side Plate. J Orthop Trauma. 1999;13(1):5-8.
7. Shah M, Aharonoff G, Wolinsky P, Zuckerman J, Koval K. Outcome After Hip Fracture in Individuals Ninety Years of Age and Older. J Orthop Trauma. 2003;17(8):6-11.
8. Lee Y, Huang H, Lo T, Huang C. Dynamic hip screw in the treatment of intertrochanteric fractures: a comparison of two fixation methods. Int Orthop. 2006;31(5):683-8.
9. McLoughlin S, Wheeler D, Rider J, Bolhofner B. Biomechanical Evaluation of the Dynamic Hip Screw With Two- and Four-Hole Side Plates. J Orthop Trauma. 2000;14(5):318-23.
10. Laohapoonrungsee A, Arpornchayanon O, Phornputkul C. Two-hole side-plate DHS in the treatment of intertrochanteric fracture: Results and complications. Injury. 2005;36(11):1355-60.
11. Verhofstad M, Werken C. DHS osteosynthesis for stable pertrochanteric femur fractures with a two-hole side plate. Injury. 2004;35(10):999-1002.
12. Ho M, Garau G, Walley G, Oliva F, Panni A, Longo U et al. Minimally invasive dynamic hip screw for fixation of hip fractures. Int Orthop. 2008;33(2):555-60.
13. Wong T, Chiu Y, Tsang W, Leung W, Yeung S. A double-blind, prospective, randomised, controlled clinical trial of minimally invasive dynamic hip screw fixation of intertrochanteric fractures. Injury. 2009;40(4):422-7.
14. Alobaid A, Harvey E, Elder G, Lander P, Guy P, Reindl R. Minimally Invasive Dynamic Hip Screw. J Orthop Trauma. 2004;18(4):207-12.
15. DiPaola M, Rozbruch SR, Helfet DL. Minimal incision technique using a two hole plate for fixation of stable intertrochanteric hip fractures. Orthopedics. 2004;27:270–4.
16. Gotfried Y. Percutaneous Compression Plating of Intertrochanteric Hip Fractures. Journal of Orthopaedic Trauma. 2000;14(7):490-495.
17. Pajarinen J, Lindahl J, Michelsson O, Savolainen V, Hirvensalo E. Pertrochanteric femoral fractures treated with a dynamic hip screw or a proximal femoral nail. A randomised study comparing post-operative rehabilitation. J Bone Joint Surg Br. 2005;87:76–81.
18. Ekstrom W, Karlsson-Thur C, Larsson S, Ragnarsson B, Alberts K. Functional Outcome in Treatment of Unstable Trochanteric and Subtrochanteric Fractures With the Proximal Femoral Nail and the Medoff Sliding Plate. J Orthop Trauma. 2007;21(1):18-25.
19. Gadegone W, Salphale Y. Proximal femoral nail – an analysis of 100 cases of proximal femoral fractures with an average follow up of 1 year. Int Orthop. 2006;31(3):403-8.
20. Menezes D, Gamulin A, Noesberger B. Is the Proximal Femoral Nail a Suitable Implant for Treatment of All Trochanteric Fractures? Clin Orthop Related Res. 2005;439:221-7.
21. Simmermacher R, Bosch A, Van der Werken C. The AO/ASIF-proximal femoral nail (PFN): a new device for the treatment of unstable proximal femoral fractures. Injury. 1999;30(5):327-32.
22. Song W, Chen Y, Shen H, Yuan T, Zhang C, Zeng B. Biochemical Markers Comparison of Dynamic Hip Screw and Gamma Nail Implants in the Treatment of Stable Intertrochanteric Fracture: A Prospective Study of 60 Patients. J Int Med Res. 2011;39(3):822-9.

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