

Treatment of hip fractures in the elderly with the “TriboFit” System: retrospective review of our experience

Giampaolo Molinari, Valter Galmarini, Fabrizio Ferrara, Roberto Capelli

Orthopedics and Traumatology unit, Fatebenefratelli Hospital, ASST Fatebenefratelli-Sacco, Milan, Italy

Received: April 25, 2021
Accepted: September 6, 2021

Correspondence

Valter Galmarini

Orthopedics and Traumatology unit, Fatebenefratelli Hospital, ASST Fatebenefratelli-Sacco, Piazza P.ssa Clotilde 3, 20121 Milan, Italy
E-mail: valter.galmarini@asst-fbf-sacco.it

How to cite this article: Molinari G, Galmarini V, Ferrara F, et al. Treatment of hip fractures in the elderly with the “TriboFit” System: retrospective review of our experience. Lo Scalpello Journal 2021;35:102-105. <https://doi.org/10.36149/0390-5276-213>

© Ortopedici Traumatologi Ospedalieri d'Italia (O.T.O.D.I.) 2021



OPEN ACCESS

This is an open access article distributed in accordance with the CC-BY-NC-ND (Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International) license. The article can be used by giving appropriate credit and mentioning the license, but only for non-commercial purposes and only in the original version. For further information: <https://creativecommons.org/licenses/by-nc-nd/4.0/deed.en>

SUMMARY

Background. We assessed the TriboFit Hip System, an acetabular “buffer” useful in surgical treatment of medial femoral neck fractures in elderly patients in which a hemiarthroplasty was implanted instead of a total hip arthroplasty. It consists of a gelatinous-plastic buffer made of polycarbonate urethane.

Methods. Between 2008 and 2011, 38 patients with medial femoral neck fracture were operated on by a single surgeon, 19 of whom were clinically and radiographically evaluated with a mean follow-up of 18 months. From 2012 to 2016, 9 patients from the first review and two new cases were re-evaluated.

Results. Radiographic imaging showed good quality of the peri-prosthetic bone in all cases in 2008-2011, without osteolysis. The Harris Hip Score was excellent and good in 79% of cases. In the subsequent review, we observed a reduction of the positive results.

Conclusions. The beginning of our experience was completely positive for good results in the short term, as in most of the scarce literature on the subject. However, after the second review, we decided to abandon the use of TriboFit Hip System, given that the results not as positive as before.

Key words: TriboFit, medial femoral neck fractures, polycarbonate urethane, hip arthroplasty, tribology

Introduction

The TriboFit Hip System (THS) is an acetabular interposition system that in recent years has brought innovation to the field of hip arthroplasty. It consists of a gelatinous-plastic “pad” made of a polycarbonate urethane (PCU) material, which has the function of “replacing” the cartilage of the acetabulum. Thanks to its tribological and design features, it allows to solve some problems related to traditional hip prostheses (Fig. 1).

The THS can be placed directly on the acetabular subchondral bone or inserted in an acetabular metal-back cup. Polycarbonate urethane mimics the function of cartilage: it has a low coefficient of friction due to its high hydrophilicity and a low modulus of elasticity, similar to that of cartilage¹⁻³. A surgical technique of press-fit implantation with minimal acetabular milling has the advantage of its application directly on bone. The tribological characteristics of the PCU, as well as the use of large diameter heads, make the TriboFit a safe and effective system, potentially ide-



Figure 1. "TriboFit" (a gelatinous-elastic bearing formed from urethane polycarbonate) is shown.

al in relatively young patients with femoral neck fracture and/or hip arthritis, in whom the decision was made not to perform a traditional total hip arthroplasty ⁴⁻⁷.

Materials and methods

Between 2008 and 2011, 38 patients with medial femoral neck fracture were operated on with THS at the Orthopaedics and Traumatology unit of the "Fatebenefratelli e Oftalmico" Hospital in Milan, Italy.

Inclusion criteria were: age between 70 and 80 years, medial femoral neck fracture (Stages 3 and 4 according to the Garden classification of hip fractures), satisfactory general conditions, and active life. Exclusion criteria were: pathological fractures, severe deformity, major osteoporosis, obesity, skeletal and metabolic disorders, lower extremity paralysis, Parkinson's disease, history of a transient ischemic attack within the past year, severe comorbidities, and poor cooperation.

A single surgeon performed all procedures (11 men, 27 women, mean age 76 years) with the postero-lateral (Moore) approach. In all cases the THS was implanted directly on the acetabular bone, after a minimal milling with removal of the articular cartilage only, in order to "exploit" all the physical characteristics of the implanted material. Tapered straight cemented femoral stems from two companies (Bio-Impianti "Korus" model, Symbios "Arcad" model), metal domes of varying diameters (44 mm to 50 mm), autoplasmic bone plugs, and pressurized, nonantibiotic bone cement were used (we later abandoned the use of cemented stems in preference for HA-coated stems).

All patients were administered antibiotic prophylaxis with a 1st generation cephalosporin in a single administration, suc-

tion drains were placed in all cases, and anti-thromboembolic prophylaxis with low molecular weight heparin was prescribed for at least 35 days. The mean duration of surgery was 65 min (SD \pm 8) with a mean peri-operative blood loss of about 300 ml. No intravenous or topical tranexamic acid, which we currently use routinely before capsular suturing, was administered ⁸.

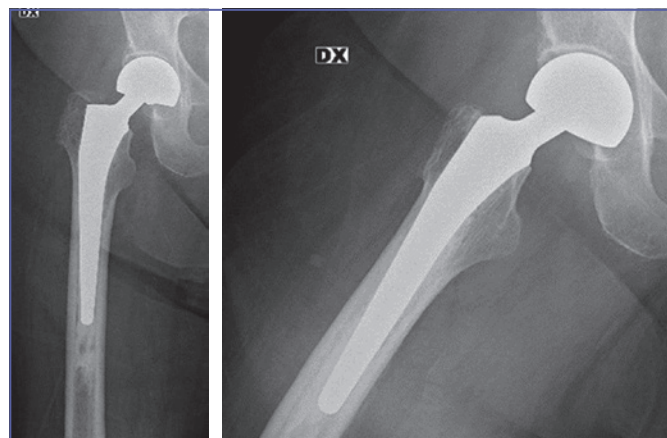
The postoperative protocol included immediate active and passive mobilization of the hip and ambulation with partial load bearing (50%) for 6 weeks; after the first radiographic check, free load bearing was allowed.

Results

Clinical and functional assessment, performed with the Harris Hip Score Scale, and radiographic assessment were performed. We were able to re-evaluate 19 of the 38 patients operated on between 2008 and 2011, with a mean follow-up of 18 months (min 1, max 26). Radiographic imaging showed good peri-prosthetic bone quality in all cases, with no osteolysis or obvious periprosthetic acetabular bone rarefaction (Figs. 2-3). The Harris Hip Score was excellent in 42% of cases, good in 37%, sufficient in 16%, and poor in 5%.

One patient, excluded from the revision, underwent surgery to remove the THS and place a traditional acetabular prosthetic component due to loosening related to a major hip injury at 16 months after implantation. There were no dislocations, probably due to the relatively large size of the femoral heads used (44-50 mm); there were no sciatic nerve palsies, vascular lesions or infections.

During 2012-2016, we reviewed 11 patients, including 9 from the first series and 2 new ones, with a mean follow-up of 38 months, observing an increased prevalence of sufficient (64%) and poor (9%) results (Tab. I), compared to the first follow-up sample.



Figures 2-3. X-ray Control after 3 years of a hip hemiarthroplasty placed with the TriboFit Hip System.

Table I. Results according to Harris Hip Score.

Parameters	2008-2011 19 patients	2012-2016 11 patients
Excellent (90-100)	8	-
Good (80-89)	7	3
Sufficient (70-79)	3	7
Bad (< 70)	1	1

Discussion

The main potential benefit of THS is that only acetabular cartilage must be removed, without milling of the subchondral bone, granting results similar to those achievable with a total hip arthroplasty in elderly people with medial femoral neck fractures, with good life expectancy, in whom, due to general conditions, it is opted not to implant a total prosthesis.

The surgical procedure is fast and with limited bleeding, the instrumentation is simple, and the implantation does not present technical problems in experienced hands (still with a moderately steep learning curve, as became evident later). As mentioned, tissue saving is remarkable; the implant is press-fit; the groove made in the acetabular bone, which will contain the circular tooth of the THS, is shallow and relatively easy to perform. Since the acetabular subchondral bone is virtually intact, tissue is left for future replacement of the implant with a conventional acetabular component in the event of mechanical loosening.

We had welcomed the TriboFit System: in our opinion, compared to hemiarthroplasty surgery (which we reserve for elderly patients with low life expectancy), it could have reduced the risks of possible cotyloiditis and arthritic evolution of the cup. The use of this system in the prosthetic treatment of femoral neck fractures in the elderly patient had, in our opinion, some potential advantages: the PCU, although with a thickness of only 3 mm, is about 70 times less rigid and with a wear rate about 12 times lower than ultra-high molecular weight polyethylene, with an elasticity similar to that of articular cartilage; microscopic analysis of the implants after mechanical tests demonstrated a low level of damage of the articular surfaces of the implants⁹. THS allows the preservation of acetabular bone and the use of large diameter femoral ball heads, which provide better articulation and stability without the risk of impingement^{2,3,9-13}. This reduces the risk of periprosthetic osteolysis of ultra-high molecular weight polyethylene, as well as the risks of breakage of ceramic components and an increase in metal ions in blood levels characteristic of metal-on-metal prostheses^{8,13}. The size and morphology of the debris that is generated stimulates less reactivity than other types of surfaces¹⁴⁻¹⁶.

In the first 2 years of follow-up, postoperative pain was practically absent, range of motion recovery was optimal, and the

operative time was slightly longer than with hemiarthroplasty, with minimal risk of dislocation. However, after the initial enthusiasm, we noted an increase in pain and a reduction in ROM with less satisfactory results; we hypothesized that material wear and the related inflammatory process, or buffer mobilization may have occurred⁹.

Nonetheless, having then extended the use of the method to other, less experienced, surgeons, it seemed quite evident that the learning curve was more challenging than we previously thought.

As a result of these findings, we gradually abandoned the use of THS in the treatment of femoral neck fractures, towards traditional total prosthetic replacement.

The literature confirms our experience in the short to medium postoperative period.

In 2009, Siebert et al. underlined positive results in a multi-center study on 50 patients, operated for hip arthritis and femoral neck fractures, with a mean follow-up of 28 months⁶. Mai et al., in 2017, emphasized the full satisfaction for the method on a case series of 27 patients with hip arthritis followed from 2007 to 2011; the average Harris Hip score had improved from 40 to 86, without adverse events and without any radiographical evidence of wear or mobilization of the acetabular components⁵.

Lazic et al. in 2020 presented a review of 149 arthroplasties with an improvement in Harris Hip, Oxford Hip and EuroQol scores ($p < 0.001$) at 3 years follow-up. Painless squeaking was reported in only 12 patients¹⁷.

The literature also reports short-term failures due to buffer wear as in the Anglo-Canadian study by Biant et al.¹⁸. Finally, we were not able to find any long-term studies (let alone randomized ones) on the subject, which is probably a sign of progressive loss of interest in the method by the scientific community.

Conclusions

The great challenge in the field of arthroplasty has always been to reproduce as closely as possible a healthy hip joint, both in terms of functional-mechanical and biological-tribological aspects.

The tribological characteristics of the PCU, as well as the use of large diameter heads, made THS potentially safe, effective, with few complications, and ideal in relatively young patients with good bone quality affected by femoral neck fracture, in whom it is decided not to implant a traditional arthroplasty.

While patients followed within 2 years after surgery demonstrated viability of THS for hip reconstruction in medial femoral neck fractures, with almost always satisfactory results, in the subsequent monitoring in 79% of cases the clinical pictures were not equally positive: the scarce literature on the subject confirms the good results in the short and medium term, while long-term studies are lacking.

Despite our initial enthusiasm, we have gradually resumed using the traditional method of total hip replacement. The experience gained represented professional growth, thanks to the use of new materials and, not least, allowed us to propose to the patient an alternative surgical option. The progressive abandonment of the method, shared by the experiences found in the literature, underlines in our opinion how the long-term reliability is not such as to guarantee the patient an optimal survival of the implant.

Ethical consideration

None.

Acknowledgement

None.

Funding

None.

Conflict of interest

The authors have not obtained funding and do not have contracts or other forms of financing, personal or institutional, with public or private entities.

Author contributions

The Authors contributed equally to the work.

References

- Wippermann B, Kurtz S, Hallab N, et al. Explantation and analysis of the first retrieved human acetabular cup made of polycarbonate urethane: a case report. *J. Long Term Eff Med Implants* 2008;18:75-83.
- Schwartz CJ, Bahadur S. Development and testing of a novel joint wear simulator and investigation of the viability of an elastomeric polyurethane for total-joint arthroplasty devices. *Wear* 2007;262:331-339. <https://doi.org/10.1016/j.wear.2006.05.018>
- Scholes S, Unsworth A, Jones E. Polyurethane unicondilar knee prostheses: simulator wear tests and lubrication studies. *Phys Med Biol* 2007;52:197-212. <https://doi.org/10.1088/0031-9155/52/1/013>
- McTighe T, Treharne R, Greene A. Design rationale and clinical review of a new compliant bearing materials for acetabular reconstruction. Chagrin Falls, Ohio, US: JISRF 2009.
- Mai S, Mai B, Siebert WE. The use of polycarbonate-urethane as an acetabular shell bearing surface: a 5-year prospective study. *Hip Int* 2017;27:472-476. <https://doi.org/10.5301/hipint.5000483>
- Siebert WE, Mai S, Moroni A. A two-year prospective and retrospective multi-center study of the TriboFit Hip System. *J Long Term Eff Med Implants* 2009;19:149-155. <https://doi.org/10.1615/jlongtermeffmedimplants.v19.i2.60>
- Siebert WE, Mai S, Kurtz S. Retrieval analysis of a polycarbonate-urethane acetabular cup: a case report. *J Long Term Eff Med Implants* 2008;18:69-74. <https://doi.org/10.1615/JLongTermEffMedImplants.v18.i1.570>
- Galmarini V, Molinari GP, Pitti E, et al. Riduzione delle perdite ematiche con l'utilizzo dell'acido tranexamico in pazienti anziani con frattura del collo del femore operati con protesi. *Giornale Italiano di Ortopedia e Traumatologia* 2019;45:155-159.
- Elsner JJ, Mezape Y, Hakshur K, et al. Wear rate evaluation of a novel polycarbonate-urethane cushion form bearing for artificial hip joints. *Acta Biomater* 2010;6:4698-4707. <https://doi.org/10.1016/j.actbio.2010.07.011>
- Gabarré S, Herrera A, Mateo J, et al. Study of the polycarbonate-urethane/metal contact in different positions during gait cycle. *Biomed Res Int* 2014;548968. <https://doi.org/10.1155/2014/548968>
- St John K, Gupta M. Evaluation of the wear performance of a polycarbonate-urethane acetabular component in a hip joint simulator and comparison with UHMWPE and cross-linked UHMWPE. *J Biomater Appl* 2012;27:55-65. <https://doi.org/10.1177/0885328210394471>
- Moroni A, Nocco E, Hoque M, et al. Cushion bearings versus larged diameter head metal-on-metal bearings in total hip arthroplasty: a short-term metal ion study. *Arch Orthop Trauma Surg* 2011;132:123-129. <https://doi.org/10.1007/s00402-011-1364-8>
- Berry DJ, von Knoch M, Schleck CD, et al. Effect of femoral head diameter and operative approach on risk of dislocation after primary total hip arthroplasty. *JBJS* 2005;87:2456-2463. <https://doi.org/10.2106/JBJS.D.02860>
- Elsner JJ, Shemesh M, Mezape Y, et al. Long-term evaluation of a compliant cushion form acetabular bearing for hip joint replacement: a 20 million cycles wear simulation. *J Ortho Res* 2011;29:1859-1866. <https://doi.org/10.1002/jor.21471>
- Moroni A, Hoque M, Micera G, et al. Impiego del polycarbonato-uretano nell'artroplastica dell'anca. *Giornale Italiano di Ortopedia e Traumatologia* 2011;37(Suppl 1):50-55.
- Smith RA, Hallab NJ. In vitro macrophage response to polyethylene and polycarbonate-urethane particles. *J Biomed Mater Res A* 2010;93:347-355. <https://doi.org/10.1002/jbm.a.32529>
- Lazic S, Kellett C, Afzal I, et al. Three-year results of a polycarbonate urethane acetabular bearing in total hip arthroplasty. *Hip Int* 2020;30:303-308 <https://doi.org/10.1177/1120700019836426>
- Biant LC, Gascoyne TC, Bohm ER, et al. Retrieval analysis of a failed TriboFit polycarbonate urethane acetabular buffer. *Proc Inst Mech Eng H* 2016;230:251-256. <https://doi.org/10.1177/0954411915625171>