Operative treatment of flat foot

Flatfoot is a type of deformity morphologically caused by the collapse of the plantar arch and by a valgus deformity of the hindfoot; from the functional view point the foot is kept prevalently or persistently over-pronated throughout the entire stride phase. During the first four years of life the foot is physiologically pronated and therefore does not require any treatment. If the foot continues to over-pronate after age of five, then bracing becomes necessary until approximately age 8; if over-pronation persists after this age or if bracing has not been instituted, surgery becomes the recommended treatment option. The ideal age range for treatment is between 8 and 12 years of age. The clinical investigation should rule out the following conditions before recommending surgery: still flatfoot due to tarsal coalition, severe ligament laxity, neurological pathologies and outcomes of clubfoot.

In collecting the patient's history it is important to ask about occasional pain, unwillingness to walk long distances or early fatigue: all these signs are indicative of abnormal function. The two most obvious physical findings are a reduction of the plantar arch and a valgus deformity of the hindfoot. In severe cases, there may also be abduction and supination of the forefoot. Two tests are fundamental for an exhaustive examination of the foot: the Jack's test, which consists in applying passive tension to the calcaneo-stop procedure was introduced. This device is made out of a resorbable material, Poly-L-lactic acid, which maintains its mechanical properties for about 12 months and is then resorbed over the following 5 years, therefore without needing to be explanted. A small incision is made at the level of the tarsal sinus; the fibers of the sustentaculum tali (retinacular fibers) are then separated thereby exposing the tarsal sinus. The implant site is prepared using an awl at the calcaneal level, just in front of the subtalar joint; after tapping, a 540 Medica RSB calcaneo-stop screw is then positioned.

If the foot does not achieve 90° dorsiflexion after surgery, percutaneous lengthening of the Achilles tendon should be performed. If only the screw has been implanted, the patient will be put in a walking leg cast for 2 weeks; if the heel cord has been lengthened, the leg cast should be worn for 5 weeks, of which the first 2 weeks without weight bearing. Upon removal of the cast, normal shoeing and physical activities like cycling and swimming are recommended.

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References

PRE-DF POST-DF

Briefly

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References
Trabecular Titanium™

Trabecular Titanium™ is a three-dimensional, multiphase, regular, hexagonal cell structure characterised by a high open porosity that imitates the morphology of the trabecular bone (Figure 1).

This innovative material is made from Titanium, one of the metals mostly used in orthopedics thanks to its unique combination of attributes, as light weight, high biocompatibility and excellent mechanical properties, especially in terms of resistance to fracture and fatigue.

The interconnected geometric structure is created with Electron Beam Melting (EBM) technology in a single manufacturing phase. EBM allows the production of Titanium (or titanium alloy) components using an extremely high power electron beam that selectively melts the powders and precisely creates any three-dimensional design involving either dense or porous parts. TT is not a coating: the absence of an interface between the trabecular structure and the bulk guarantees structural solidity, high resistance and prevents the risk of detachment and galvanic effects.

The geometric repetition of the base cell produces a uniform and highly porous external surface that is responsible for a very high friction coefficient. This is fundamental to maximise primary stability, both in cortical and cancellous bone, because a tight initial press-fit between implant and bone provides the optimal conditions for secondary fixation by bone in-growth.

Several factors have been identified as being crucial for the optimisation of bone remodeling: intrinsic factors, like bone stock quality, and extrinsic factors, like implant design and materials properties. Three-dimensional architecture and surface texture of prosthetic elements play a key role in biological performance. Higher porosity and an adequate pore size are expected to enhance cell migration and vascularisation, facilitating the transport of oxygen, nutrients, ions and bone inducing factors, favoring new bone formation. All these features (biocompatibility, optimal pore size, high porosity, geometry) have been combined to create the Trabecular Titanium™ structure.

In vitro analysis of genetic expression in human osteoblast-like cells demonstrates that Trabecular Titanium™ is able to stimulate osteoblasts proliferation and differentiation and to limit osteoclastogenesis. Furthermore, it has been proven that it induces a down-regulation of several genes involved in the inflammatory process and modulates genes related to immune system. These results lead to the conclusion that not only the material but also the structure significantly affect cell proliferation.

The effective osteointegrative potential of TT has been analysed in comparison to traditional porous Titanium coatings in a bilateral implantation sheep model. Histomorphometric results demonstrated that TT is able to ensure significantly high bone in-growth percentages, both in cancellous and cortical bone (Figure 4).

Preliminary results from a multicentre prospective densitometric study on 89 patients (91 hips) that underwent primary THA with a DELTA-TT cup reported a postoperative recovery of bone mineral density in DeLee and Charnley zones starting from 12 and 24 months after surgery.

Radiographic assessment confirmed the optimal osseointegration and therefore the stability of the acetabular cups. Already at 12 months, x-rays showed all the most sensitive signs that are reported to be indicative of bone in-growth; the absence of radiolucent lines, the presence of a super-lateral dense bone buttress at the bone-cup interface, the presence of medial stress-shielding in DeLee and Charnley zone II, the presence of radial trabeculae oriented in the direction perpendicular to the cup surface in DeLee and Charnley Zone I or Zone II and the presence of an inter-medial bone buttress (Figure 5).

Relevant clinical outcomes have been reported: the average Harris Hip Score and range of motion significantly improved from preoperative evaluation to 24 months.

A subjective evaluation of the general health status by SF-36 revealed a significant improvement in patients’ quality of life with values higher than normalised ones for all scales already at 12 months. The early improvement in clinical and functional recovery after THA with DELTA-TT cup has also been proven: a clinical study performed on 150 patients with an average follow-up of 12 months.

References
First Implants with Trabecular Titanium™

Thanks to the remarkable and continuous improvements in surgical techniques, in biomaterials and in implant design, total hip arthroplasty has reached excellent results. Based on our experience, we use several products to face the daily difficulties in the operating room. Unfortunately the “perfect” prosthesis does not exist yet, so it is necessary to evaluate and balance advantages and disadvantages to get the best results for the patients. There are many ongoing studies on new biomaterials; a great number of these are focused on reproducing the morphology of real bone: Trabecular Titanium™ is one of these. Its bone-like elastic modulus and high compression resistance makes it suitable for joint replacements. Trabecular Titanium™ has been integrated in the DELTA-TT acetabular system creating cups with a trabecular surface that favours bone ingrowth and guarantees an adequate osteointegration and an effective primary stability. We appreciated Trabecular Titanium™ from the beginning: in fact we observed its positive results in revision surgeries, and also in major cases of acetabular defects where a strong primary fixation was fundamental. Then we decided to use Trabecular Titanium™ also in first implants in patients with coxarthrosis (primary or secondary), with dysplasia, with trauma and osteonecrosis. 36 patients (mean age 77) have been treated with DELTA-TT acetabular cups from June 2008 to December 2010. The initial diagnosis were: 25 patients with primary coxarthrosis, 6 patients with hip dysplasia, 3 patients with avascular necrosis and 2 patients with post traumatic head necrosis. We found that especially in the cases of secondary coxarthrosis, despite of a correct pre-operative planning, it was frequent to find extremely poor bone conditions due to degenerative changes of both bony and soft tissue implying bone defects. In such cases it is fundamental to have a system that guarantees the management of every type of difficulty. For example, considering the cases in which primary stability is not enough, the DELTA-TT system offers the possibility of inserting up-to three screws.

Short-term results with the DELTA-TT cup

Between 2008 and 2011, 109 DELTA-TT cups in Trabecular Titanium™ were implanted in 98 patients, 65 males and 43 females, with an average age of 63 and 65 years respectively. The acetabular component was coupled to different types of stems. All patients were evaluated both radiographically and clinically with the Harris Hip Score (HHS) at the pre-operative examination, at 3, 6 months after surgery and then yearly. The current mean follow-up is 15 months (min. 2, max. 36). The total mean HHS value and all specific domains significantly improved from pre-operative evaluation to the last follow-up. The X-rays revealed no signs of loosening or migration of the cups, nor periacetabular signs of osteolysis. The inclination angle was within the physiological range of 40±5 degrees of coverage in all cases. One case of revision was necessary due to early septic loosening. A staged re-operation was planned: removing the cup, there was no evidence of osteointegration due to the local infection. In another case of revision due to recurrent dislocation, the cup appeared to be completely osteointegrated therefore was not removed. The surgeon opted to cement a retention cup into the original acetabular implant. All other patients presented satisfactory clinical outcomes and none complained persistent pain or any other discomfort related to the prosthetic implant.

Initially, the DELTA-TT cup was to be implanted in the younger and most active patients with good acetabular bone stock. Then, thanks to the high osteointegrative potential of Trabecular Titanium™, the indication was further extended to older patients with porotic acetabular bone stock. Hip reinforcement screws were used in 7 cases, never for evident micro-instability (as may occur with other implants), but only as a further safety measure in porotic bone. Besides primary and secondary stability, another advantage of this acetabular cup is the possibility of using ceramic, metal or polyethylene liners, depending on the patient’s needs and clinical condition. The DELTA-TT cup provides immediate satisfactory results and guarantees excellent primary stability, both in young patients with good bone stock quality and in elderly patients with poor one. As for all new biomaterials, a longer clinical and radiographic follow-up is necessary.

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For more than 120 years it has been known that the joint surfaces of the human knee femur predominantly roll while flexing from full extension to about 40° of flexion; and, for the remaining degree of flexion a combination of rolling and gliding occurs.

In the stance phase, the femur rolls backwards over the tibia plateau, while further flexion causes increased gliding.

If a prosthesis was designed where both, the medial and lateral tibial surfaces have concave shapes (picture A), then the femur would necessarily rotate around its own centre of rotation and also around the centre of rotation of the tibial joint surfaces. The resulting instantaneous centre of rotation of the joint does not allow a predominant rolling. However, this design would have the benefit of high flexion angles.

Bilateral convexity (picture B) with pure rolling as a consequence would, however, limit the range of motion to small flexion angles because of the limited space. Therefore in the human knee rolling and gliding is combined.

The design of the Aequos G1 Knee Endoprosthesis combines both principles of construction. Medially the tibia is concave and laterally is convex. This kinematics is based on the principle of a quadruple joint. The four morphological axes of rotation are the midpoints of the curvatures of the medial and lateral femoral condyles and the medial and lateral tibia plateau.

In addition, the medial and lateral compartments are shifted a few millimeters in a sagittal direction, the medial tibia plateau being concave and the lateral plateau convex. In most knee arthroplasties these factors are not taken into account; instead they are equipped with symmetrical medial and lateral joint surfaces.

Within the framework of the authorization tests, the endoprosthesis was examined in a knee simulator according to ISO/WC 14243 (standards). The abrasion rates were, thereby lower than, or at least as good as, those of conventional endoprostheses. Within principal, nature uses the same mechanism to reduce wear and load of the cartilage during walking or running. At the same time, it makes use of the anterior posterior translation of the femur (“roll back”) to increase leverage forces for the extension mechanism and, to minimize contact forces of the patellar femoral joint. The Aequos G1 Knee Endoprosthesis imitates the natural roll-glide mechanism by optimizing surface radii while positioning the joint compartments in the appropriate way.

In 2005 Lima developed an eccentric glenosphere, with the aim of lowering the centre of rotation, maintaining the correct position of the metal-back, in order to prevent the scapular notching occurring with concentric designs.

We performed a retrospective study with the aim to evaluate clinical and radiographic outcomes of the eccentric glenosphere and to ascertain if this design can be a solution to prevent scapular notching. This study reports the results of 20 patients, treated between 2006 and 2008, with a minimum 24-month follow-up.

Clinical and radiographic evaluation was performed preoperatively and at 1 month, 3, 6 months, 1 year and annually thereafter. All patients have been evaluated with MRI or CTscan preoperatively and with x-rays postoperatively to evaluate the scapular notching and to measure prosthesis-scaphular neck angle (PSNA), peg-glenoid rim distance (PGRD) and the distance between the scapular neck and glenosphere.

At last follow-up (average 27.5 months, range 24-46 months) the Constant Score and ROM improved significantly. The average PSNA was 92°± 25 mm, the average PGRD was 21.2 mm ± 9 mm and the average distance between the inferior bony glenoid rim and the inferior edge of the glenosphere was 4.3mm ± 0.8 mm.

No scapular notching and no implant-related complications were observed. Our conclusion is that this data suggest that the use of an eccentric glenosphere allows the lowering of the COR, with correct positioning of the metal-back in reverse shoulder arthroplasty. And this can reduce the risk of scapular notching.