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Organizing Committee
Department of Orthopaedics
31-501 Krakow, ul. Kopernika 19, Poland
tel. (+4812) 430 3220, fax (+) 430 3153
www.efort.pl e-mail: icl@efort.pl

Chairman
Prof. Edward Czerwiński
tel. (+4812) 430 3209, fax (+) 430 3210
e-mail: czerwinski@orthopaedics.pl



DIAGNOSIS AND PREVENTION OF DDH

Wojcik J.
Department of Pediatric Orthopaedics, Karol Marcinkowski University of Medical
Sciences, Poznan, Poland

There is a very long way from diagnosis to treatment of the developmental dysplasia of the hip. Everything is complex: clinical examination is subtle and requires a long training. Treatment is not as simple as could be thought. The risks include approximate examinations and of standard, ready-made ones. The discussion has not been settled as to whether all children with hip instability can be clinically detected at birth. The complexity of the problem arises from the fact that only 10% of children who have instability at birth develop long-term problems if they are left untreated. It is well known, affirmed by several different studies that at birth the incidence of hip instability is approximately 1-4% of patients, with figure being higher in girls. There is also a consensus that a large majority of these unstable hips will become stable during the first few days of life, even without treatment. **What is not known**, however, is how many of those hips that become stable will become completely normal as the child grows. These two fundamental issues are of the utmost importance. They emphasize the significance of early examination (first 48 hours) in order to detect instability and employ careful follow-up of any newborn in whom hip instability has been identified.

Some children are at particular risk of hip instability. Those infants are labelled as "high risk". They include children born in families with hip instability, those presented by breech, first born children or products of oligohydramniotic pregnancies, particularly girls, those with the generalized joint laxity, those with torticollis and scoliosis, those with foot deformities and increased birth-weight over 4000g. Whilst all children should be screened at birth by a doctor experienced in clinical examination with particular attention directed to those children, who are considered high risk.

It must be emphasized that **clinical examination** is the most important for the detection of hip instability in newborns. Clinical examination should be very delicate,

gentle, based on feelings rather than signs. Clinically, hip instability can be divided into: 1. irreducible dislocation, 2. reducible dislocation, 3. dislocatability, 4. subluxability. The clinical tests of instability were described by Ortolani and Barlow. Fully dislocated irreducible hip is a very rare condition and may be associated with neuromuscular abnormality. It represents dislocation well before delivery. In this form acetabulum is vacant, femoral head palpable posteriorly. There are no signs of Ortolani and Barlow tests. We can only find the signs of “pump”, which means there exists a movement along the long axis of the leg. This is the most severe pathology of the hip in DDH. The reducible dislocation is characterized by the Ortolani manoeuvre. With the hip flexed 90 degrees, we abduct the hip and then we feel and hear the click which is the sign of the reduction of the hip. Dislocatable and subluxatable are the most common types of pathology of the hip in DDH. This deformity arises at the end of pregnancy. This is characterized by positive Barlow test, which is the provoked-dislocation test. Using it we can dislocate or subluxate the hip. It is very rare to find restricted hip movements in newborns. The limited abduction of the affected hip is the sign typical for older children, more than 3 months of age. It is crucial to repeat the clinical examination even during the same office visit. **Ultrasonography** has changed our diagnostic ability for DDH. These direct examinations help us in hip evaluation in the first days of the newborn period. The exact Graf classification and methodology makes possible to classify all types of hip pathology irrespective of the examiner. Another important feature of ultrasonography is the ability to monitor the treatment not only in newborn period.

How to start with the prevention of DDH in newborn period? There is no any really good screening without collaboration of orthopaedics surgeons and paediatricians. To achieve this, we must control our own environment, especially maternity hospitals and constantly keep paediatricians, paediatric nurses and obstetricians informed. There is no consensus in screening programs – general or limited. I personally recommend limited program. All newborns should be examined clinically after the delivery. The infants with positive or doubtful clinical signs and those with signs of high risk should be examined ultrasonographically immediately after delivery within first 2 weeks. The other children should be screened ultrasonographically at the time when most of the hips are mature enough. It is important, that if we live in the region with high percentage of late detected DDH (more than 3 months of age) the general clinical and ultrasonographical screening program should be used.

L02

CONSERVATIVE TREATMENT Of D.D.H.

Cigala F., Lotito F.M., De Felice D.

Clinic Orthopaedics, University “Federico II”, Napoli, Italy

The D.D.H screening programme until the second half of '80 was based on the clinical Ortolani-Barlow's manoeuvre at newborn age and by x-ray examination of the pelvis at three – four month old to discover hip joint anomalies that could be address at a future dislocation. Never less the so-called Dislocation of the Hip was a quite common pathology around Europe. The close reduction of a dislocated hip has been the treatment of choice in order to attempt to reduce a dislocated hip without surgical operation. Close reduction was preferred to be obtained after a period of skin traction on bed, at which a special frame were added, to perform a progressive gentle reduction gaining, in an average of three weeks time, complete abduction before applying a spica cast. Two main methods were used: reduction with the hips extended, abducted and internal rotated according to Sommerville- Petit and reduction in over head position with the hips flexed, abducted and external rotated. These two systems were designed to decrease the Avascular Necrosis of the femoral head that often occurs if the reduction was obtained during a sudden manoeuvre under general anaesthesia.

Generally the correct position of the femoral head into the acetabular socket, at the moment to apply the plaster, was assessed by an arthrogram, to avoid the bad surprise of further dislocation due to false reduction after the traction period.

The child so treated had to be followed during her/his growth to assess the development of acetabular roof and the position of the femoral head linked at the antversion of the femoral neck. Any hip joint, in which acetabular index do not improve during growth, needs acetabular and femoral osteotomies to overcome these anatomical defects as cause of a persisting genetic defect.

At the end of '80, a deep change of the natural history of D.D.H. in Italy is related to the introduction of screening programme based on accurate clinical examination of the hip of the babies at the nursery, selection of babies with risk signs of D:D.H. such as clinical anomalies, instability of the hip at Ortolani-Barlow's, familiarity for D.D.H. and breech delivery. The hips of those babies are immediately assessed by ultrasonographic examination according to Graf's method. The general population, on the contrary, is examined by US between the second and the third months of age. The National Health Service encourages the US screening paying its cost. In this way the incidence of late-D.D.H. and late-dislocation is enormously decreased and the outcome of the pathology has been improved. The conservative treatment of the hip affected by different grade of anomalies early discovered trough US examination, in fact, are treated by simple harness in abduction for mild dyspalsia to plaster spica cast in human position if the hip is severely unstable and Ortolani positive. There are some rare cases of true Congenital Dislocation at birth that can not be conservatively reduced and it will be necessary to perform a open reduction generally when the ossified nucleus of femoral head appears.

Our experience:

From 1975, when our Children Orthopaedic Department was created in the Medical School of "Federico II" University of Naples and the first author become the Chief, we admitted 374 patients affected by dislocation of the hip (F=308 – M= 66 F:M= 5:1) with a mean age of 7 and half months (min.4 mths.- max 20 mths). All these

patients were put in traction on the Morel's bed in order to attempt a close reduction in extended, abducted and internal rotated position according to Sommerville- Petit method.

Average time of traction was 25 days (min. 7 max 38). 120 patients were undergone at an arthrographic examination in general anaesthesia. 46 patients did not achieve the reduction and were operated on.

A spica cast were applied for 60 days followed by an harness in abduction. Total amount of time of treatment was a mean of 7 months (min 110 days max. 12 months). Residual dysplasia was observed in 48 patients that needed a further surgical procedure.

The number of inpatient affected by D.D.H. were an average of 21 per year until 1990 to drop dramatically at 3 per year in the last decade. On the other hand the D.D.H. outpatient clinic increased. The selected babies examined were 6930 at an average age of 4 months old. All the babies were undergone to clinical and US examination and classified according to Graf. Hip anomalies were seen in 630 babies. The treatment was related to clinical and US observation. Simple abduction pillow or simple harness in abduction were used in hip clinically negative at Ortolani-Barlow's manoeuvre and 2c or 2b type according to Graf.'s classification. Milgram harness or Coxaflex harness (Thamert –Burgwedel –Germany) or plaster spica cast in "human position" were applied in instable hip type D or worse and clinically positive at Ortolani-Barlow manoeuvre. 25 patients were hospitalised because affected by irreducible hip.

Conclusion:

The experience that we have done over decades in treatment of D.D.H. confirms the assumption of Treadwell and Bell (1981) that claimed that D.D.H. screening deeply changed the natural history of D.D.H. The problem was to find a good screening test helpful to diagnose as soon as possible a pathological hip.

Graf's method, after a decade of scientific criticism, can be elected at a worth method to screen an infant hip. Screening program based on ultrasound and clinical examination decreases hospitalisation, cost and sequels of D.D.H. in term of surgical operation and degenerative arthritis of hip joint at least at a medium follow up. The hip that need to be hospitalised are the true congenital dislocated hip for which early diagnosis probably should not effect their clinical history.

A danger is hidden in US screening. Ultrasonography has to be performed by a skill examiner and it has to be implemented by careful clinical examination with anamnestic recording of the data in order to obtain the best result of the D.D.H. screening program.

L03

CLOSED OR OPEN REDUCTION

Dungl, P.

Orthopedic Clinic Bulovka, Prague, Czech Republic

Introduction: The incidence of DDH has decreased dramatically during the last thirty years. The first reason was the introduction of targeted examination of all newborn babies (in the Czech Republic since 1977) and then our system was adopted by all of the other European countries. In the 1960s about 15% of all children were treated for different stages of hip dysplasia and there were 3% of true dislocations. These very high numbers of less serious grades of DDH are partially due to over-diagnosis and over-treatment. In the 1980s, the numbers had been reduced to 5% of dysplasias and 0.8% of dislocations. The introduction of ultrasound examination according to Graf within the first week of life has contributed to further reduction of DDH cases.

Material and Methods: Open reduction is indicated only for congenitally dislocated hip joints in which tender, conservative reduction cannot be done. As a tender reduction, this can only be made by continuous overhead traction with a gradual increase of hip abduction from 10 to 60 degrees. When reduction cannot be considered as harmless, the surgical procedure consisting of open reduction and derotational osteotomy should be performed before the age of one year. In children older than the age of eighteen months a pelvic osteotomy must be added

Results: From 1980 to the end of 2000 (a period of 21 years), 147 dislocated hip joints in 128 children were operatively treated. The average follow-up was 11 years (2 – 21). In the age group of up to 15 months of age, 68 hip joints (62 patients) had open reduction and a derotational osteotomy was added in 32 cases (47%).

An additional pelvic osteotomy in cases of simple open reduction was performed on 17 hips (47%) and on 10 hips (31%) in cases of open reduction and derotation.

Aseptic necrosis developed in 5 cases (7.3%), but it is difficult to distinguish between pre-existing necrosis after conservative treatment and postoperative necrosis.

In the age group of 15 months to 36 months, there were 47 hip joints in 42 children. The surgery consisted of open reduction, varus and derotational osteotomy plus Salter (exceptionally Pemberton) osteotomy. The rate of necrosis was 12.8% (6 cases).

The open reduction in children older than the age of 3 was performed in 24 children (32 hip joints). The open reduction, varus and derotational osteotomy of the femur were performed in all cases. The Salter osteotomy was performed in 12 hips, Pemberton in 5, triple pelvic osteotomy in 6 cases, and Chiari was used in primary reduction in 9 cases.

The necrosis rate was 6.2% (2 cases).

In the targeted study regarding the effectivity of overhead traction, we had 90 hip joints in 76 patients. In the group of primary treatment in our institution (57 hip joints), successful reduction was reached in 80.1% of cases, but in the group of 33 hip joints where primary treatment had failed, conservative treatment was successful in only 30% and open reduction was performed in 23 cases.

We used the radiological classification according to Severin and clinical score according to Merle D'Aubigne: Severin I - excellent results - 12%, Severin II – good

– 63%, Severin III – fair – 15%, Severin IV – poor – 6%, Severin V – re-dislocation, 6 cases – 4%. The necrosis rate was 9%.

Conclusion: Conservative and operative treatment of DDH are not two competing methods. The treatment of each dislocation starts conservatively. Only when there is no chance for harmless, tender reduction of the femoral head into the acetabular socket, the open reduction should be indicated and performed by experienced specialists. Early open reduction with femoral derotation gives statistically significant better results in comparison with only open reduction. The percentage of excellent results seems to be low, but it must be kept in mind that a hip joint which was operated and had an open reduction heals, in the majority of cases, at least radiologically. Functional results do not correspond in childhood with the radiology. Despite that, the children in the time period of FU do not complain, and the patients with operated DDH in the natural history must be considered as a high risk for the development of secondary coxarthrosis.

L04

ARTICULAR COVERAGE, ACETABULAR PROCEDURES

Tönnis D., Syburger Str. 14, D-44265 Dortmund, Germany

In this paper operations are discussed that improve the dysplastic acetabular roof in developmental dislocation of the hip (DDH) of children up to 10 years. In the first year of life acetabular dysplasia can be treated successfully by flexion-abduction splints and plaster casts in „human position“. From the second year on, only slight dysplasias can heal spontaneously or be treated conservatively. Then the steep acetabular roof has to be osteotomized and levered down to a normal angle and coverage to avoid redislocation or residual dysplasia.

Different procedures have been described in the course of time. Two osteotomies are chiseling in the anterior to posterior direction. Salter's innominate osteotomy levers the whole acetabulum with the lower part of the pelvis in an antero-lateral direction around an axis passing through the pubic symphysis and the posterior part of the osteotomy. In Pemberton's osteotomy the hinge for turning down the acetabular roof is the last, posterior, transverse cortical segment over the triradiate cartilage, short before the sciatic notch.

Osteotomies chiselling from lateral in medial direction have been described already by Albee (1915) and Jones (1920). Lance (1925) propagated this technique in Europe. Here the acetabular roof is partially osteotomized in a thickness of 5-7 mm. Only the lateral part of the acetabulum is brought into the horizontal position. Wiberg in 1939 used this technique, but in 1953 he was the first to publish a full osteotomy what Dega called 1973 a transiliac osteotomy. Dega had originally learned the technique of Lance, but in 1963 when he reduced high dis-locations after the technique of Colonna,

he performed also a full transiliac osteotomy. After the Symposium of Chapchal in Basel 1965 we started in Berlin also with the complete acetabular osteotomy. With the control of an image intensifier the blade of the osteotome is driven toward the posterior rim of the triradiate cartilage leaving only a small bony rim above. Anteriorly the blade passes through the ant. inf. iliac spine. Posteriorly it just enters the sciatic notch. Here we check the blade position by direct palpation. The acetabulum is bent down partly in the small rim of bone left and mainly in the triradiate cartilage. Angles up to 50° have been achieved, which you cannot reach by other techniques.

In the beginning we have combined after Mittelmeier and Witt this acetabulo-plasty with a varus osteotomy of the femur. In our long-time follow-up (Brüning et al. 1988,1990) however, we found in almost 50% a subcapital coxa valga or a so-called head-in-neck-position of the femoral head. Then we avoided varus-osteotomies and had good results without it (Pothmann).

To keep the acetabular roof in the new position we used first bone wedges from the varus osteotomy, then deproteinized bone wedges from animals, and today deep frozen wedges of human femoral heads of the bone bank, sterilized at 121 degrees C for 20 min. (Ekkernkamp, Katthagen). A firm layer of cortical bone laterally is necessary. Reinvestigations have proven the stability of this material too (Pothmann). This type of acetabular osteotomy in our and other authors' opinion is the best. Salter's osteotomy is not as efficient in severe dysplasia. And in older children it produces a decrease in anteversion of the acetabulum, which may limit internal rotation of the hip and cause osteoarthritis if it does not improve. In Pemberton's osteotomy one cannot use the image intensifier, which is of great help to perform the osteotomy exactly and also the levering of the acetabulum to the optimal coverage.

Our first long-time follow-up of children with additional varus-osteotomies (Brüning et al.) reviewed 90 hip joints in 67 children. The age at operation was in average 3.6 years, the age at follow-up 15 years.

Clinical results. 98% of the patients had no pain or only occasional, no limitation of movement and normal or almost normal gait. The Trendelenburg sign was negative in 71% of the cases, grade 1 in 15.5% and grade 3 in 13.5%.

Radiological evaluation. The mean value of the AC-angle (acetabular index) preoperatively was 33.8°, postoperatively normal with 16.3°. The acetabular angle of the weight-bearing zone was at follow-up 9.7°, which is normal too. At the age of less than 18 years the CE angle of 25,9° was normal too, as well the instability (protrusion) index of Reimers of 12.3 % and the distance femoral head to teardrop figure with 8.8 mm.

In our study group of hip dysplasia we introduced a score of normal values of hip measurements and 3 grades of deviation from normal, slightly pathological, severely pathological and extremely. When we counted normal values and slightly pathological

ones together as a good result, we found for the different measurements of the acetabulum percentages mainly between 82 and 93 %. Remarkable were two measurements of the femoral neck, the epiphyseal index with only 50 % of normal and slightly pathological angles and the head-neck index with 47.7% respectively. This was due to the head-in-neck position of the femoral neck after varus osteotomy as we have mentioned already.

Acetabular coverage is achieved best in transiliac osteotomies up to 10 years. Then, only by triple pelvic osteotomies the acetabulum in total can be redirected to a normal coverage. But this operation is more difficult. Residual dysplasias therefore should be treated as early as possible in the way demonstrated here.

L05

FEMORAL OSTEOTOMIES FOR DDH IN THE ADULT

F. Langlais, J.C. Lambotte
Rennes, France

In early secondary arthritis due to femoral dysplasia, varus osteotomy achieves a control of arthritis for two decades in 80 % of cases: it is therefore a very reliable conservative treatment. Moreover, in carefully selected cases of severe arthritis in young active patients, a valgus osteotomy can achieve pain relief for a decade in 70 % of cases.

THE VARUS OSTEOTOMY

is recommended when the arthritis is due to a coxa valga $\geq 140^\circ$. By reducing the inclination angle to 125° the abductors level of arm is optimised, and their contracture is decreased. Therefore, the osteotomy reduces the surface strains, but it does not improve the extent of articular surfaces.

A – INDICATIONS

1) Four factors are mandatory to achieve long term improvement :

- The arthritis must be the consequence of the dysplasia, with degenerative changes localized at the supero lateral part of the head and of the acetabulum. This can be confirmed by isotope scanning. If the arthritic changes are not localised the disease is rather a primary arthritis, or an inflammatory or a metabolic disease, which are not an indication for a biomechanical treatment.
- There must be a real coxa valga, evidenced by coxometry. Anteversion is measured by CT scan, and the inclination is measured on a X ray of the pelvis with the hips in internal rotation equal to the anteversion. If there is a shortened femoral neck (such as a post reduction osteonecrosis), the modification of the glutei lever of arm may not change significantly the articular strains, and therefore osteotomy is no indicated.

- The articular congruency must not be impaired by the reduced inclination angle. Pre operative X rays with the hips in an abduction equal to the planned varisation must not reveal any lateral narrowing of the joint space, which would mean incongruity, and lead to failure.
- The possibility of articular healing must be important: varus osteotomy is recommended before 45 years, and if the joint space remains $\geq 50\%$ of normal.

2) Therefore varus osteotomy is not recommended:

- in a non symptomatic dysplasia (as some of them may not lead to arthritis), or if the symptoms are those of a labrum syndrom, with suddent pain, instead of a progressive and mechanical arthritic pain.
- if the dysplasia is only acetabular : then only the acetabulum has to be treated.
- if the anatomic abnormality is not an increase of the inclinasion (neck-shaft) angle, but a modification of the head-neck angle, which causes impigement with the labrum, and which is not improved by inter-trochanteric osteotomy.

3) The associated dysplasia have to be taken into consideration

- If there is a femoral hyperanteversion there are two different conditions in the adult :
 - if the patient walks with internal rotation of knees (convergent strabismus of patella), realising a dynamic correction of hyperanteversion, the association an external rotation of the femur to the varisation is recommended.
 - but if, despite hyperanteversion, walking is without abnormal rotations of the knees, this means that the optimum congruity of the hip is in that position. An ostotomy is no advocated as, instead of retroversing the femoral neck, it would rotate externally the femoral shaft.
- If there are both an acetabular and a femoral dysplasia, they both have to be treated :
 - if an augmentation is recommended for an anterolateral defect, the shelf osteoplasty can be performed in the same operation that the varus osteotomy.
 - if a medialisation is necessary (Chiari), both osteotomies can be associated in one stage.
 - but if a complex reorientation osteotomy is necessary (either periacetabular – Giacometti-,
 - or pelvic –Ganz-), it could be hazardous to perform a varus osteotomy at the same time.

B – SURGICAL TECHNIC

- The importance of the varisation depends on that of the coxa valga. The final inclinasion angle must be 125° , as the lever of arm of the abductors is impaired for a lower angle. Moreover there is a post operative limping due to the ajustement of the glutei length, the duration of which is function of the

varisation (one year per 10°). To reduce this limping, only the necessary varisation has to be made.

- The technic has several important points :
- non union is avoided by non dissection of the medial metaphysis or removal of a wedge :
- we use a subperiosteal osteotomy, leaving in contact the medial cortex, with a lateral opening, fixed by a nail plate as a tension band. This technique gives a minimum limb shortening (12 mm for 15° varisation).
- respect of the articulation and soft tissues. There is no arthrotomy as the nail plate is inserted on a guide pin. Later implantation of the THR will not be complicated by the previous osteotomy.
- precise, « automatic » correction, depends only on the nailplate angle.
- the resistance of the osteosynthesis allows immediate rehabilitation (this extra articular operation does not reduce ROM), and 10 to 20 kilos weight bearing. Full weight bearing is authorized at three months.

C – RESULTS

There are less than 5 % mechanical complications. An antalgic effect is obtained within some weeks. In 80 % of cases, painlessness and absence of radiological deterioration for two decades is achieved, a THR becoming necessary in the third decade. In 20 % of cases, only a temporary effect is obtained, leading to a THR after 5 to 10 years.

THE VALGUS OSTEOTOMY

is at present used in only seldom cases of young patients with a severely damaged articulation, but who prefer an antalgic conservative surgery than a THR, because they wish to continue for a decade a strenuous activity not compatible with an arthroplasty. This can be made only when there are two large osteophytic drops of the acetabulum and of the femoral head, which can be put into contact by the valgisation, and facilitate healing of the superior lesions. In carefully selected cases, a relief of pain is achieved for a decade in 70 % of patients.

IN CONCLUSIONS

The femoral varus osteotomy remains one of the most reliable conservative operations in osteoarthritis due to DDH. However to achieve these good results, a clear understanding of the indications and biomechanical demands of this operation is required.

In seldom and selected cases of severe arthritis, a palliative valgus osteotomy can achieve a decade of pain relief.

REFERENCES

1. Valgus osteotomy in severe osteoarthritis of the hip.
F. Langlais, JL. Roure, P. Maquet
J. Bone Joint Surg., 1979, 61 B, 424-431

2. Ostéotomies de l'extrémité supérieure du fémur
F. Langais, JC. Lambotte
Tech. Chir. Ortho. Traum., 44, 654, 16 pages. Encycl. Med. Chir. (Paris) 1999
3. Osteotomies of the upper femur.
M.E. Müller
55470 A 10 (9 p) Surg. Techn. Orth. Traum. EFORT – Elsevier Ed 2002

L06

MANAGEMENT OF EARLY HIP OA IN THE ADOLESCENT

Dorn U., Neumann D.
Orthopaedic Clinic, Salzburg General Hospital

DDH with or without previous treatment is the most frequent source of early hip OA in adolescents. Others are hip joint deformation following Legg-Calve-Perthes disease, slipped capital epiphysis or trauma. Secondary OA after rheumatoid arthritis, bacterial infection or as result of a hemophilic hip joint are relatively infrequent.

The choice of treatment depends on the type of the deformity and the severity of osteoarthritic changes. Osteotomies are favourably performed in adolescents. Arthrodesis is rarely accepted in this age group. In selected individuals THR is the matter of choice.

Pain, limping gait, restricted joint motion and sometimes clicking phenomena are the usual complains. Pain is usually aggravated by running and other sports activities.

Residual dysplasia of the hip with a spherical femoral head is best treated by a triple periacetabular osteotomy. The Bernese osteotomy of Ganz (3) and the triple osteotomy of Tönnis (9) are popular procedures. They mobilise an acetabular fragment, then reorient and stabilise the fragment in an optimal position. Internal fixation with screws provides stability and allows early mobilisation with partial weight bearing.

Chiari's osteotomy is a supracetabular rotatory displacement osteotomy. Femoral head and joint capsule are medialised and covered by the osteomised iliac bone. The joint capsule in the weight-bearing zone is transformed into fibrous cartilage by time. Congruent remodelling of the acetabular roof and fibrous tissue transformation into cartilage are biased by improper height and orientation of the osteotomy (5). There is still an indication in severe DDH with subluxation of the femoral head and those with a severely deformed femoral head.

In pathomorphologies with aspherical femoral heads femoral osteotomies, usually valgus osteotomies, are required additionally in order to optimise the joint congruency. A dysplastic hip in a high dislocation and moderate to severe OA are contraindications.

Radiographic work up includes pelvic ap view and faux profile view. Assessment of the anterior and posterior acetabular rim indicate orientation of the acetabulum in terms of anteversion / retroversion. Orientation of the subchondral sclerosis over the

femoral head is an indicator of femoral head coverage as CE-angle and AC-angle. 20°-30° abduction view in neutral rotation mimics the postoperative acetabulum / femoral head relation. From CT-scans acetabular orientation (anteversion / retroversion), degenerative bone cysts, posteroinferior joint space and femoral head deformities and femoral neck osteophytes are depicted. Labrum pathology is detectable by MRT and MRT-arthrography.

After treatment of DDH deformation of the femoral head and neck due to ischaemic necrosis develop in an incidence up to 20 %, depending on the method. Premature closure of the epiphyseal plate can also follow trauma, septic arthritis and Legg-Calve-Perthes disease. Most often an combination of acetabular dysplasia and coxa magna with short femoral neck and a high-standing greater trochanter are typical deformities. Specchiulli's classification (8) is very helpful for deformations after avascular necrosis in DDH. Limping gait due to femoral shortening and insufficient strength of the abductor muscles are the major complains of adolescents. Symptoms exacerbate during walking of longer distances and restrict sports activities. Valgus osteotomy, Y-osteotomy, transfer of the greater trochanter alone or in combination with valgus osteotomy are appropriate methods to restore a better function and improve alignment of the mechanical axis to the knee joint. Femoral neck lengthening osteotomies (1,4) with distal-lateral transfer of the greater trochanter are advocated by several authors. Restoration of almost normal anatomy muscle function of the hip joint is realistic aims of these methods.

If the abductor muscles deficit is dominant and only a minor leg length discrepancy is in slight deformities, e.g. some Specchiulli's type B2, we do not always need such complex procedures. Isolated transfer of the greater trochanter also improves the lever arm of the abductor muscles and therefore joint function, but does not influence leg length discrepancy. Disappearance of the Trendelenburg-type gait is the most visible improvement of this procedure (7).

Total hip replacement (=THR) is rarely indicated in adolescents, but sometimes necessary for restoration of a almost normal quality of life. Especially in severe symptomatic OA after septic arthritis or trauma in some individuals remain only two options: arthrodesis or arthroplasty. Arthrodesis is a permanent solution for many years or even lifetime. Gait function is compromised remarkable (6) and specific compensatory mechanisms are adopted when walking. Excessive motion in the lumbar spine and ipsilateral knee provokes back and knee pain as well as osteoarthritic changes on the long run.

THR in young patients includes the risk of several revisions over lifetime, due to wear problems particularly in physically active individuals. A deficient acetabular bone stock as usual in severe acetabular dysplasia or poor bone quality after trauma or septic arthritis may compromise primary stability and secondary osteointegration. Nevertheless functional results and outcome (2) in terms of life quality are superior compared with various non-substituting procedures.

1. Buess P, Morscher E. Die schenkelhalsverlängernde Osteotomie mit Distalisierung des Trochanter major bei Coxa vara. Orthop Prax 1988; 9: 576-581

2. Dudkiewicz I, Salai M, Chechik A, Ganel A. Total hip arthroplasty after childhood septic hip in patients younger than 25 years of age. *J Pediatr Orthop* 2000; 20(5): 585-7
3. Ganz R, Klaue K, Vinh TS, Mast JW. A new periacetabular osteotomy for the treatment of dysplasia of the hip. *Clin Orthop* 1988; 232: 26-36
4. Graf R, Tschauer C, Klapsch W. Dreifachosteotomie des proximalen Femures bei Coxa vara mit Hochstand des Trochanter major und Beinverkürzung. *Operative Orthopädie und Traumatologie* 1992; 4(1): 50 – 62
5. Lack W, Windhager R, Kutschera HP, Engel A. Chiari pelvic osteotomy for osteoarthritis secondary to hip dysplasia. Indications and long-term results. *J Bone Joint Surg Br* 1991; 73-B: 229-234
6. Karol LA, Halliday SE, Gourineni P. Gait and function after intra-articular arthrodesis of the hip in adolescents. *J Bone Joint Surg Am* 2000; 82(4) : 561-9
7. Menapace C, Dorn U. Die Trochanterverlagerung als Therapie der Abduktoreninsuffizienz bei Trochanterhochstand. *Orthop.Praxis* 1986; 6: 449-453
8. Specchiulli F, Scialpi L, Solarino GJR, Laforgia R. Avascular necrosis in congenital dislocation of the hip: long term results and proposed new classification. *Hip Int* 1995; 5: 72-81
9. Tönnis D, Behrens K, Tscharani F. Eine neue Technik der Dreifachosteotomie zur Schwenkung dysplastischer Hüftpfannen bei Jugendlichen und Erwachsenen. *Z Orthop* 1981; 119: 253-263

L07

PATHOLOGY AND CONSERVATIVE MANAGEMENT OF KNEE OSTEOARTHRITIS

Prof. Klaus-Peter Günther, MD

Orthopaedic Department, University of Dresden, Germany

Knee osteoarthritis (OA) is a major cause of pain and disability in elder people. The prevalence of radiographic OA in a population aged 35-74 years is 5-15% and about one third of involved people complain of symptoms. In the „Ulm Osteoarthritis Study“ patients undergoing total knee replacement reported a mean duration of knee pain of 10 years prior to surgery.

Multiple genetic, constitutional and environmental factors contribute to the development of OA. Initial cartilage degradation leads to joint space narrowing and early osteophyte formation which can be observed radiographically. Whether elevated subchondral bone mineral density is contributing to manifestation of the disease or just a secondary reaction process is still under debate. OA finally involves not only cartilage and subchondral bone but also soft tissues in and around the joint (synovial

membrane, ligaments and muscles), which often results in painful effusions, muscular shortening and stiffness.

Many conservative treatment options have been developed in the past to relieve these symptoms and to slow down or even stop the cartilage degradation process. Evidence to support the effectiveness of individual treatments, however, is variable. Recently the EULAR Committee for Clinical Trials determined an approach for the development of evidence based guidelines for conservative treatment of knee OA (Pendleton et al, Ann Rheum Dis 2000;59:936-944). Through a process of quality assessment of available publications and determination of expert consensus employing a Delphi approach propositions relating to a rationale conservative management could be made:

Treatment of knee OA must be tailored to individual patients, taking into account factors such as age, comorbidity and the presence of inflammation. Optimal management requires a combination of non-pharmacological treatment modalities (regular education, exercise, appliances and weight reduction) and pharmacological approaches. Paracetamol generally is the preferred analgesic and there is enough evidence to support its application, as the pain controlling effects are comparable to NSAIDS and long-term application is safe enough. NSAIDS (oral or even topical) can be considered in patients with effusion. Although some studies found NSAIDS to have better efficacy than paracetamol in the treatment of painful knee OA, the gastrointestinal side effects limit their long-term application. Therefore most experts consider their application only in patients unresponsive to paracetamol and in major effusions. In such situations long-acting steroids can be injected intra-articularly as well. While the effects of steroids in knee OA have been assessed in a number of studies, the predictors of response are still somewhat unclear and further investigations are necessary.

Recent data seems to support the theory that some symptomatic slow acting drugs (glucosamine sulfate, chondroitin sulfate, diacerein and hyaluronic acid) may possess structure-modifying properties. Further studies, however, are necessary to determine the pharmacoeconomic aspects of that treatment and to define the indications more precisely.

Education should be an integral part in the management of knee OA. Several large randomised controlled trials have shown benefits of different educational techniques in reducing pain and increasing coping skills. Function can reliably be improved by quadriceps strengthening exercises and there is enough evidence to show the positive effects of weight reduction on the progression of the disease process.

In conclusion, evidence based guidelines in the conservative management of knee OA exist. Orthopaedic Surgeons should have knowledge of the various approaches and be aware of the fact that certain clinical propositions are supported by substantial research based evidence, while others are not.

L08

ARTHROSCOPY IN KNEE OSTEOARTHRITIS

Friederich NF, König U, Petsinis G

Department of Orthopaedic Surgery & Traumatology, Kantonsspital, CH-4101

Bruderholz/Switzerland

Introduction

There are numerous arthroscopic techniques available for the treatment of femorotibial osteoarthritis. Advances in arthroscopic technology have made arthroscopic treatment a widespread accepted treatment. Short-term pain relief after arthroscopic treatment in degenerative conditions of the knee has been well established, however this not the case for the long-term results.

One of the reasons why arthroscopic procedures are well accepted is the favourable risk–benefit ratio, when compared to more invasive procedures like realignment osteotomies, unicompartmental or even total knee arthroplasty (15,16,17,18,19,21,26) Very often the arthroscopic procedure is offered to the patient as a temporising or “time gaining” measures (11,23,24). However their efficacy is often unequal. Almost no prospective controlled studies are yet available. Arthroscopic mosaicplasty techniques as well as arthroscopically assisted autologous chondrocyte transplantations are – in this context – not regarded upon as treatment options for the osteoarthritic knee and are therefore described elsewhere.

Arthroscopic techniques in knee osteoarthritis

- (Partial) Meniscectomy
- Chondral Shaving
- Removal of osteophytes
- Removal of loose bodies
- Synovectomy
- Subchondral drilling techniques (Pridie)
- Abrasive chondroplasty
- Microfracturing techniques

Results published in peer-reviewed journals

- (Partial) Meniscectomy: Results more dependent on the status of the knee joint, than on the age of the patient (15,17). For the treatment of chondrocalcinosis there are controversing results: Many authors found actually chondrocalcinosis to be an adverse prognostic factor (6,8,19). Meniscectomy is not always a benign procedure (5)
- Chondral Shaving: This technique of chondral debridement, removal of cartilaginous flaps etc. has become very accepted with the advent of motorized instruments. Positive short-term results have been published, on the long-term this treatment however still fails to have proven efficacy (1,2,3,9,10,11). In some

- studies simple needle lavage, as performed by many rheumatologists, proved as effective as the arthroscopic method (4,8,17).
- Removal of osteophytes: Several studies show a benefit, when mechanically disturbing osteophytes are removed (3,16)
 - Removal of loose bodies: One of the most rewarding arthroscopic techniques. Only free bodies in the anterior compartment of the knee are responsible for blocking, catching and/or pain (6,9)
 - Synovectomy: At the first moment making sense – removing inflamed synovia may be of benefit to the patient, we caution. Even when utilizing some of the newer radio-frequency ablation devices (Arthrocare® etc), important postoperative hemarthrosis may occur and may cause longstanding postoperative problems after knee arthroscopy (18,19)
 - Subchondral drilling: Originally described by Pridie in 1959, this technique of “subchondral stimulation” creating and stimulating re-growth of type I collagen layers has been adapted to arthroscopic techniques (22)
 - Abrasive chondroplasty: This rather aggressive technique, introduced by Lanny Johnson in 1986, has a decreased popularity, since almost nobody but the creator reported good mid- to long-term results (7,12,13,25)
 - Microfracturing: A similar technique to the Pridie drilling technique, however avoiding any heat damage due to the fact that the perforations of the subchondral plate are performed by “ice-picks”. Its advocates report good to excellent results on the short-term (20,27,28)

L09

CHONDRAL TRANSPLANT IN KNEE OSTEOARTHRITIS

Lars Peterson
Gothenburg, Sweden

Osteoarthritis is the end stage of a gradual process of degradation of the cartilage and secondary responses in other tissues within a joint after many years of use. It is common in the knee joints in elderly. The surgical treatments for OA are often symptomatic, such as arthroplasty and HTO. Traumas to the knee, especially in combination with other injuries such as ACL rupture or meniscal tears, can lead to a speedy process and premature OA. The osteoarthritic patient often experiences a gradual on set of symptoms such as pain and swelling on weight bearing, catching and locking and in late stage nightly pains, leading to a very limited lifestyle. If it is possible to treat the OA at an early stage and thus hindering the destruction of the joint, much is won for the patient.

Autologous chondrocyte transplantation (ACT) is a treatment for focal chondral and osteochondral lesions in the knee joint. The technique has also been used on patients

with early stages of OA in knee, including multiple lesions, kissing lesions, lesions in combination with malalignment, instability and total meniscectomy. When treating these patients it is important to not only focus on the cartilage lesions but also on other pathology. A high tibial osteotomy should be considered, especially if there is a malalignment, but also as an unloading procedure if the lesion is large or if there are bipolar kissing lesions. If the patient has had total or subtotal meniscectomy meniscal allograft transplantation may be indicated. Ligamentous instability from a ruptured ACL for example must also be treated. All these procedures can be done prior to or after the ACT, but mostly concomitant with the ACT. As the patients have often been symptomatic for a long time and the greater surgical trauma with a concomitant procedure, it is harder to regain knee function after the surgery. Close contact between the patient, the doctor and the physical therapist is imperative, so measures can be taken if the patient does not progress accordingly.

Young patients with early OA are hard cases. These patients often have a high demand on knee function and have had a high level of activity but are disabled by their symptoms. When treating these patients with ACT it is important to assess and treat all pathology that may jeopardize a good outcome.

L10

OSTEOTOMY IN THE TREATMENT OF KNEE OSTEOARTHRITIS: PLANNING, TECHNIQUES

Jakob R.P., Marti Chr., Gautier E.
Fribourg, Switzerland

Osteotomies around the knee are still utilized a lot in Europe and in Asia while in US unicompartmental and total arthroplasty for the same indications have more and more taken over, partially due to fear of complications. We think that with careful planning and technique the indications can be maintained. Furthermore with modern methods of cartilage repair it is of utmost importance to unload overloaded compartments. Also many young patients having suffered ligamentous tears of the knee and having been reconstructed are in need of OT's later on.

Many of the poor results are due to absent or poor planning and to poor OT technique and fixation. Not every knee needs to be operated to an overcorrected position. While opening wedge OT has become trendy because of fewer neurological complications we think there are definite indications for closing wedge technique.

In this lecture we would like to summarize the principles and the steps which are very personal and that are based on 20 years of practice.

Indications for osteotomies around the knee

Varus Knee

Opening wedge osteotomy: Advantages: Rapid surgery, small incision, fast healing, precise correction. Indicated when:

- Degree of OA moderate and angular correction of not $>8^\circ$
- Useful in associated MCL Instability
- Useful when open surgery on medial femoral condyle needed (Mosaicplasty)
- In case of associated ACL instability when tibial slope is not $>10^\circ$
- Patella alta

Has a tendency to increase the tibial slope.

We use tricortical grafts from the iliac crest where the base of the wedges in mm corresponds to the degrees of correction. A cervical spine AO plate with for screws is used for fixation.

Creates less deformity of the proximal tibia which is an advantage for a later total knee. Increases the intraarticular pressure even when the MCL is cut or detached distally, without us knowing the effect on the degree of OA, no long-term studies being known to us.

Closing wedge osteotomy: Advantages: Allows higher degrees of correction

- Degree of OA advanced, need for higher corrections
- Useful when open surgery on lateral femoral condyle needed
- In ACL instability when tibial slope must be corrected, because of need to break the medial cortical hinge a heavier implant is needed may be enforced by a sagittal Ex.Fix.
- Patella baja

Corrections over 5 degrees need an OT of the proximal or distal fibula. We perform the resecting OT in the fibular neck, the proximal cut is incomplete removing only the anterior and lateral cortex, the distal cut is complete. This allows to shift the distal fragment proximally and in front of the proximal cortical shelf allowing nerve protection.

For fixation of the tibial OT we use the 90° angled cannulated AO osteotomy plate, that is inserted over a 2,0 K wire using a specific "transporteur" in relation to the amount of correction. The OT is done using the precise AO osteotomy jig, cutting along 2,5 mm K wires inserted through the jig. The two cuts meet 5-10 mm short of the opposite cortex.

The closing wedge OT creates more deformity, carries a certain risk of peroneal nerve injury and of compartment syndrome. Surgery must therefore been done very skilfully and demands expertise.

All the studies about long-term effect of HTO have been done one using closing wedge technique.

Double Osteotomy

Indications:

- For deformities of over 12° to avoid obliquity of the joint line otherwise created by tibial or femoral OT alone.

- When sagittal deformity needs to be corrected together with frontal plane deformity, eg a flexum of 20° and a varus of 10°.

Valgus knee

Closing wedge Osteotomy of the distal femur: Advantages are the potent fixation using the same plate as on the tibia leading to rapid healing. Approach is rather extensive. Indicated:

- When deformity of valgus and sagittal plane (flexion contracture) need to be addressed.
- When valgus is marked (in small deformities the OT can also be performed in the tibia).

Opening wedge Osteotomy of the distal femur. Indicated:

- When the deformity is small.
- When cartilage gestures need to be performed on the lateral femoral condyle.

Planning of Osteotomies:

We use one leg standing films in ap, pa 45° flexion, and lateral projection, varus-valgus stress films with 15 kp (Telos) and Orthoradiogramm (hip-ankle). A potential contralateral opening on the standing film is compensated on the drawing by a push orthoradiogram which virtually brings both compartments into contact.

For the varus knee the ideal crossing point of the mechanical axis sits at 30% in the lateral compartment, the centre between the tibial eminences being 0% the medial or lateral border of the tibia being 100%. This is the displacement corresponds to the classical 3° overcorrection that is useful when the medial compartment is down to bone. This would be an overcorrection for the less damaged medial joint lines where however an OT may already be indicated.

We therefore have prospectively studied and validated a more balanced approach.

If the medial compartment in a varus knee has lost up to one third of his cartilage the axis is calculated to pass at 10% in the lateral compartment.

If is down by two thirds it is meant to pass at 20% laterally.

If it is totally worn it passes at 30%.

The drawing for the high tibial OT on the orthoradiogram is simple:

1. Connect the centre of the femoral head with the point at 10, rsp. 20, rsp. 30% in the lateral compartment and prolong this new axis of the leg distally to a point lateral of the ankle joint.
2. Now select the hinge joint for the opening or closing wedge OT 2-3 cm distal to the joint line and connect this point with the old and the new centre of the ankle. Measure the angle between the t line which corresponds to the amount of correction and the angle to open or resect.

The planning for the varus OT of the distal femur in valgus deformity is somewhat more complicated but should aim at a correction which leaves a femorotibial valgus of 1-2°.

Using these rules one is able to reach adequate correction.

Literature

Gautier E, Thomann BW, Brantschen R, Jakob RP.

Fixation of high tibial osteotomy with the AO cannulated knee plate.
Acta Orthop Scand. 1999 Aug;70(4):397-9. No abstract available

Gautier E, Jakob RP.

[The value of corrective osteotomies—indications, technique, results]
Ther Umsch. 1996 Oct; 53(10):790-6.

Lattermann C, Jakob RP.

High tibial osteotomy alone or combined with ligament reconstruction in anterior cruciate ligament-deficient knees. Knee Surg Sports Traumatol Arthrosc. 1996;4(1):32-8.

Jakob RP, Murphy SB.

Tibial osteotomy for varus gonarthrosis: indication, planning, and operative technique.
Instr Course Lect. 1992;41:87-93. Review. No abstract available.

Miniaci A, Ballmer FT, Ballmer PM, Jakob RP.

Proximal tibial osteotomy. A new fixation device.
Clin Orthop. 1989 Sep;(246):250-9.

L11

EARLY AND LATE RESULTS OF OSTEOTOMIES

Odenbring S.

Department of Orthopaedics Hässleholm – Kristianstad, Box 351, S-281 25
Hässleholm, Sweden. E-Mail: sten.odenbring@skane.se

Introduction

Osteotomy for medial gonarthrosis is most often done as a proximal tibial valgus osteotomy, either as a closing wedge osteotomy (HTO) or as an opening wedge osteotomy including hemicallostasis (HCO).

In case of lateral gonarthrosis the osteotomy is done as a proximal tibial varus osteotomy, closing or opening wedge or as a distal femoral varus osteotomy depending on the anatomy of the knee.

The early period after osteotomy is influenced by complications to osteotomy. Complications depend on the operative method and localisation of surgery.

Short- and long-term results are presented as knee scores or survivorship of high tibial osteotomy. Most often used scores are the HSS-score, NHP-score and the knee scores according to Lysholm and Tegner. Scores from the patient's perspective are NHP, SF-36. KOOS (Knee Injury and Osteoarthritis Outcome Score) was introduced recently, and only short-term results are available.

Results

Osteotomy for medial gonarthrosis

Immediate postoperative results

The closing wedge osteotomy is the golden standard and reported complications are peroneal palsy in 0 – 8%, infection in 1 – 3%, fracture of the tibial plateau and delayed union in 3 – 5% and thromboembolism in 2 – 4%.

When the opening wedge method including HCO is used peroneal palsy is extremely seldom, delayed union is reported in 2%, major pin-tract infection in 2 – 20% and thromboembolism in 2 – 4%.

Short-term results

The short-term results are generally good and one to two years after osteotomy excellent and good results are reported in 85 – 97%. All five partial scales in KOOS with the exception of sports / recreation function were significantly improved 3 – 4 months postoperatively.

Long term results 5 – 20 years after surgery

Evaluations of osteotomies using survivorship of the osteotomy, with conversion to a total knee as the endpoint, show an expected rate of survival of 73-94% at 5 years, 51-85 % at ten years, 39-68 % at 15 years and 30% at 20 years. Analysis of risk factors show that age older than 50 years, presence of lateral tibial thrust and insufficient valgus correction were significantly associated with probability of early failure.

Evaluations using knee scores with a mean follow-up time of 5 – 10 years show excellent and good result in 64 – 80%. At follow-up 11- 15 years after surgery the fraction good and excellent knees is 55 - 60% and 16- 20 years after osteotomy a minority of the knees are good or excellent, at most 46%.

Stage of arthrosis: Good long-term results are reported for knees with early medial arthrosis with at most obliteration of the medial joint space or just minimal bone attrition. Results after HCO on knees with more advanced gonarthrosis are reported with a short follow-up and the change of osseous correction after osteotomy was less compared to HTO.

Only minimal progress of arthrosis after osteotomy is reported in most papers. The results of some studies indicate that the greater the surgical correction, the slower the progress of the medial joint arthrosis.

Alignment of the knee:

Most reports find better clinical results and less risk for failure when the osteotomy is corrected to a slight overcorrection of the knee alignment. There is however no consensus on the smallest correction needed to change the load on the medial arthrotic compartment.

Osteotomy for lateral gonarthrosis

The condition is uncommon and a minority of the papers on osteotomy for gonarthrosis concern osteotomy for lateral gonarthrosis. The aim of osteotomy for lateral gonarthrosis is to achieve a varus alignment of the knee with a joint line obliquity, which after surgery is less than 10 degrees. That affects the method, which is either a proximal tibial osteotomy or a distal femoral osteotomy. Most often the aetiology of the deformity is posttraumatic.

Immediate postoperative results

When using the opening wedge osteotomy on tibia transient nerve palsy is reported in 9-50%. Infection is reported in 2% and thromboembolism in 2 – 4%. Pin tract infection when using HCO is reported in 2 –20%.

In a multicenter follow-up distal femoral varus osteotomy 11 complications were recorded in 32 patients (five non unions, three deep infections and three cases with a stiff knee).

Short-term results

Short-term results one to two years after surgery are reported excellent and good in 85 – 95%.

Results 5 – 15 years

Five to ten years after surgery good and excellent results are reported in 75 - 77%, and in 11 – 15 years after surgery in 50 – 80%. Results are much better in recent reports because of better patient selection and operative technique. The tibial varus osteotomy can be used in knees with less than 12 degrees of valgus. Furthermore the tilting of the tibiofemoral joint line should postoperatively be less than 10 degrees. Otherwise a distal femoral osteotomy should be used. Persistent excessive obliquity of the tibiofemoral joint line predisposes instability with risk of compromising the result.

To summarize: Osteotomy is effective in a patient with a medial or a lateral gonarthrosis at most Stage II according to the classification of Ahlbäck, under the age of between 50 and 60 years and of high demands by reason of lifestyle and occupation.

Aim at an overcorrection so when the osteotomy is healed you should have a slight overcorrection in valgus in medial gonarthrosis and in varus when you have a lateral gonarthrosis. Furthermore the joint line obliquity should postoperatively be less than 10 degrees.

With this selection of patients and with a good surgical technique your patient can expect a probability of having a good knee in about 70 % after ten years. After ten years it is more difficult to make a prognosis for your patients knee.

L12

UNCOMPARTMENTAL KNEE REPLACEMENT

C Dodd, Oxford

There are now a number of controlled prospective trials comparing the advantages of unicompartmental arthroplasty versus total knee replacement (Rougraff 1991, Lawrencin 1991, Newman 1998, and Price 2000). These studies all favour unicompartmental arthroplasty over total knee replacement in terms of the following. The kinematics of unicompartmental arthroplasty are better and more normal for the surgery retains both cruciate ligaments with proprioceptive input. The range of motion tends to be greater in the unicompartmental group and the function better. This is especially true of demanding activities such as ascending and descending stairs, and has been shown using gait study analysis (O'Connor 1986).

The pain relief is as good, or better, with unicompartmental arthroplasty in these studies when compared to total knee replacement, and in particular there is "a better feel" with unicompartmental arthroplasty. The complications with the smaller procedure tend to be less frequent and severe and the recovery more rapid, with a potential benefit allowing for a lower cost.

There are however certain disadvantages encountered in using unicompartmental arthroplasty when compared to total knee replacement. In general there is a higher revision rate with the unicompartmental arthroplasty and this is particularly borne out in the Swedish Knee Arthroplasty Register. Using the strict criteria of Insal/Stern they suggest an incidence of 1:20 patients suitable for unicompartmental arthroplasty, and with such small numbers it is hardly surprising that there is a higher complication rate. The advantages of unicompartmental arthroplasty in the young remains controversial. In particular there are few comparative studies (Broughton and Newman 1988).

In a small study from Oxford we have found that the pain relief and function in the unicompartmental arthroplasty group were substantially better with an age match comparison group using a patient based question score (The Oxford Knee Score 0-48). We sent the Oxford questionnaire to the HTO patients of the main proponent of osteotomy surgery in the UK, who has devoted a lifetime to perfecting the art of osteotomy surgery. These patients represent the "best case scenario" and his patients at five year follow up scored 27/48 on the Oxford Knee Score. Age match group of young unicompartmental arthroplasty patients scored 38. Comparison of total knee replacement group would score 35, and it is of interest to note that those patients revised from a failed high tibial osteotomy to a total knee replacement raised their

scores from 27 to 33. There are of course disadvantages comparing unicompartmental arthroplasty and high tibial osteotomy in the young. The main disadvantages that artificial material is implanted and there is the potential for infection. What remains debatable and controversial is the outcome of procedures when converting them to a total knee replacement. In terms of 10-year survivorship most of the published literature suggests that with high tibial osteotomy there is a two-thirds survivorship, one-third being converted to a total knee replacement by 10 years (range 51% to 80%) (Naudie 1999, Coventry 1993, Rudan 1991). The similar 10-year survivorship of unicompartmental arthroplasty in patients under 65 years is in the order of 80%. This is borne out in the Swedish Knee Registry.

In general the problem with unicompartmental arthroplasty seems to centre around a higher revision rate, and faced with this problem there are a number of solutions. One can accept this and abandon the procedure, which has happened until recently in the United States. One can suggest that a unicompartmental arthroplasty is used as a pre-knee replacement, which has been forwarded by Repicci in the States. Alternatively one can try to minimise the failure rate by employing an implant with very good wear characteristics, one can concentrate on appropriate indications and one can define an accurate reproducible technique. One can seek to achieve a survival rate that is similar to that of the best total knee replacement.

The Oxford unicompartmental knee replacement was designed first by Goodfellow and O'Connor 25 years ago. It employs a spherical femoral component articulating on a flat tibial component. There is a fully mobile bearing, which is unconstrained. This bearing is fully congruent in all positions, which minimises wear.

In two published retrieval studies (Argenson and Psychoyios) 10-year wear rate was 0.03mm per year. In those cases with no impingement the rate was 0.01mm per year. There was no correlation with thickness and we now feel comfortable advising a 3.5mm bearing for long-term survivorship.

The indications for unicompartmental arthroplasty in essence centre around medial compartment osteoarthritis with a functionally intact ACL. Some superficial damage to the ligament is acceptable, but in essence the structure needs to be intact to be functioning. There needs to be a correctable varus deformity with full thickness lateral compartment articular cartilage and this is best demonstrated on stress x-ray. A fixed flexion deformity of less than 15° is usual and employing the above indications we find that a unicompartmental arthroplasty is suitable for 1:4 knees presenting with osteoarthritis.

We do not feel that the state of the patellofemoral joint is a contraindication to unicompartmental arthroplasty. We have significant evidence to corroborate this statement. In Mr Goodfellow's published series in 1998 the state of the patellofemoral joint and the clinical results did not correlate. The study by Weale (1999) there was no progression of patellofemoral osteoarthritis over 10 years. On the Swedish Registry there have been no cited revisions for progression of patellofemoral arthritis. The age and the activity of the patient does not seem to be an obvious contraindication. In particular in the old and unfit using the minimal invasive

approach there is a low morbidity, with all its attendant advantages. In the young patient (less than 50 years), the 10-year survivorship is 92% in two published series (Murray et al 1998 and Price 2000).

The published 10 year results of the designers patient (Murray et al 1998) details the follow up of 144 unicompartmental arthroplasties with a 10 year survivorship. At 10 years there were 34 knees at risk giving a 98% 10 year survivorship 95%, confidence levels 93-100%. There was one case lost to follow up giving a worse case scenario of 97%.

Of much more relevance concerns an independent series from Sweden (Svard et al 2001). These series is of 420 Oxford unicompartmental arthroplasties from a single centre performed by four surgeons. None lost to follow up. A 10+ year follow up involved 122 Oxford units reviewed, with 92% good or excellent HSS scores.

The 15 year survivorship was 94% with confidence levels 86 to 100%, there were none lost to follow up so the 15 year worse case scenario was 94%. This is better than fixed bearing unis and as good as the best total.

The Swedish Knee Arthroplasty Register however gave a different picture, and was published in 1995 (Lewald et al), reported poor early results with no learning curve and advised that the difficult implant should not be used. We in fact have gained data from 944 rather than 699 from the register. It concluded that at these centres they had very reasonable results, but one or two centres had catastrophically poor results, in the order of 30% failure. We can only conclude that these poor results were due to inappropriate indications or technique. More recently in January 2001 Robertson et al have published an update of the Swedish Knee Arthroplasty Register citing good to excellent results in those centres performing more than 23 Oxford unicompartmental arthroplasties a year. Good results were possible, but there is a definite learning curve. The phase 3 tradition of the Oxford was introduced in 1998. The aim of this introduction was to make the operation simpler and more consistent. We have consistently employed a minimally invasive approach, but we have sought to keep the advantages of phase 2 Oxford unicompartmental arthroplasty. In effect there has been minor modifications to the instruments with an increased range of sizes.

Our early phase 3 results, published in 1999 (Price et al) have compared the early recovery. This is the time taken to functional recovery, by which time the patient is ready for discharge. We compared the first 40 minimals with the last 20 opens and used 40 knee replacements taken as controls performed at the same time. We have shown that the minimally invasive unis recover three times faster than the totals ($p < 0.001$) and twice as fast as the open unis ($p < 0.001$).

Finally our one year follow up of the first 58 phase 3 Oxford unicompartmental arthroplasties reveal increase in the mean flexion from pre-operative 123° to post-operative 135°. A high proportion of the patients gained at least 130° of flexion and 50% were 140+. A mean AKS score rose from a pre of 37 to one year of 98. The AKS function score raised from a pre 53 to one year 94, with a very high proportion of patients scoring 95+ score out of 100 on the AKS.

In summary unicompartmental arthroplasties offer many potential advantages over TKR in terms of:

- Recovery, function.
- The best long term results of uni (Oxford) are now as good as best TKR.
- Unis in general are technically demanding and there is a definite learning curve.

L13

ADVANCES IN TOTAL KNEE ARTHROPLASTY: A SECOND LOOK AT THE PAST 30 YEARS.

Lemaire R.

University Hospital, Liège, Belgium

Condylar knee prostheses were designed over 25 years ago, as it became evident that the hinge prostheses previously developed were unsatisfactory because of their marked potential for loosening and femoropatellar problems.

There are currently several hundreds of different types and subtypes of condylar prostheses available and more are being introduced on the market place every year. Continuous technical development has become a familiar feature with high technology products; does this also apply to knee prostheses?

The basic designs of condylar knee prostheses already existed 25 to 30 years ago, with the Freeman-Samuelson knee implanted in 1970, the Total Condylar in 1974 and the Insall-Burstein posterior stabilized knee in 1978. Long term results are now available for these prostheses as well as for others that came next: overall, survival rates between 84% and 98% have been reported with follow-up from 10 to 25 years. Will newer implants do any better? It will take that long to know, as it has been repeatedly demonstrated that theoretical studies or tests on knee simulators are not really predictive of the in vivo behavior of an implant.

The wide variety of current implants evidently reflects commercial interests. Each of the current prosthetic knees represents a more or less unique combination of a number of features related to the geometry of the articulating surfaces, including the trochlea and patella, the resection, preservation or substitution of the posterior cruciate ligament, the type of fixation to bone; most have a modular fixed tibial bearing, with various types of fixation to the underlying metal baseplate, and an increasing number of others have a mobile bearing with restrained or unrestrained mobility in rotation and/or in AP translation. The introduction of new knee prosthesis should hopefully provide some improvement in terms of function, range of motion, and implant survival as compared with the existing knees. Such improvements have proved very difficult to demonstrate on an objective basis, all the more as the results achieved with a specific

implant do not only reflect its design, but also a number of manufacturing and processing features, and also the way it has been implanted.

We have learned a number of lessons from past failures such as

- the importance of selecting adequate materials
- the importance of an optimal manufacturing of implants (surface macro- and microgeometry, rugosity,
- the importance of an adequate sterilization technique for polyethylene
- the importance of a good trochlear design
- the dangers of resurfacing the patella using a metal-backed component.

Surgical technique has substantially improved over the years, not only because better instrumentations have been developed, but also because we have come to a better understanding of the anatomy and physiology of the arthritic knee before and after arthroplasty.

The rotational positioning of the femoral component has been extensively studied, and is now a regular feature of the operative technique. This, together with other technical factors such as improved design of the prosthetic trochlea, has to a large extent cleared the femoropatellar complications which marred the results of some early designs. Techniques for ligament balancing in the varus or valgus knee have become systematized.

The issue of preservation or substitution of the posterior cruciate ligament is still a matter for debate, but we now know that it is unrealistic to expect restoring normal knee kinematics with prosthesis when both cruciate ligaments are not intact. Posterior stabilized prostheses have been shown to provide more predictable kinematics than others intended to be closer to normal physiology.

To summarize, advances have been made over the past 30 years regarding a number of elements among which implant design was probably of lesser importance than better understanding of the anatomy and physiology of the knee, better understanding of ligament balancing and operative technique in general, as well as improved manufacturing and processing of implants.

L14

TKR IN SEVERELY DEFORMED KNEES

Nordin J.Y., M.D.

Hopital Bicêtre, Université Paris Sud, France

Treatment by TKR of severe deformities: fixed varus or valgus knee, or flexion contracture, sometimes combined (valgus and flexed knee as for example in rheumatoid arthritis) is frequently a difficult challenge. Seldom a flessum, recurvatum or malrotation have also to be managed.

These deformations, articular, extra-articular or combined can be observed in knee arthritis associated with malalignment, malunion of diaphysis, malunion of lower part of the femur or upper tibia after fracture or osteotomy, chronic juvenile arthritis or rheumatoid arthritis, Paget's or post-rachitism disease.

In 60' and 70' the most difficult cases have been frequently treated by hinge prosthesis with a high percentage of infection and loosening; many of the other cases treated with customary prosthesis had a poor follow-up because instability, luxation, patellar problems, pain or recurrence of the deformity.

Now to obtain the best prosthesis survival rate, the well trained orthopaedic surgeon has to make a good radiographical and clinical examination and the a good planification with the good choices:

- necessity or not to perform, as a first stage, an osteotomy of femur or tibia to correct a malunion or a deformity in frontal, sagittal or horizontal plane
- type of prosthesis (constrained or not, PCL sparing or sacrificing, mobile bearing),
- medial or lateral approach, and then Keblish procedure or not; tibial tubercle osteotomy or quadricepsplasty in stiff knees;
- sequence and level of tibial and femoral cuts; always perpendicular, for us, to the mechanical axis ,
- different steps of release of lateral, or medial and sometimes posterior ligamentous and capsular elements, with many controversies for lateral compartment (ilio-tibial band, collateral lateral ligament, popliteus, posterolateral capsule, biceps tendon)
- necessity of medial ligament advancement or tightening when distension in severe valgus knee,
- repair of bone loss by cement, or more usually by bone graft or metal wedge.

ARTICULAR OR PARA ARTICULAR DEFORMITIES

1) FIXED VARUS KNEE

Treatment of this deformation is usually not so difficult.

In case of postero-stabilized prosthesis implantation, after removal of medial condylar and tibial plateau osteophytes resection of PCL and release of semimembranosus tendon and postero- medial capsule are performed. Pes anserinus and collateral medial ligament release creating a subperiosteal elevation of the medial envelope is sometimes needed for good soft tissue balance; in such case a constrained plateau can be useful.

It is also possible to try PCL sparing but a good tightening of PCL is difficult and reconstruction by bone graft, metal wedge or cement or medial tibial plateau is in most cases necessary to protect tibial insertions of PCL.

2) FIXED VALGUS KNEE

We prefer the Keblish approach to have a direct look on the tightened formations (ilio-tibial band, lateral collateral ligament, popliteus.

We agree with the Krackow's classification of valgus knee in 3 groups.

For group 1, according to Whiteside it is possible to spare the PCL in the majority of cases if we accept to use a bone graft or a metal wedge on the lateral femoral condyle or/and tibial plateau taking the medial compartment as a reference. This choice of arthroplasty with PCL retention maintains the right level of the knee joint and offers often a best stability than postero-stabilized prosthesis does; PCL well tightened is a “third ligament” giving frontal stability as proved in traumatology. In fact many surgeons prefer to use postero-stabilized arthroplasty to avoid difficulties in PCL managing, and they release in different controverted steps the lateral elements. If there is instability they implant a more constrained tibial insert than usually. As communicated by Burdin it is also possible to prevent instability by performing a sagittal osteotomy of the lateral condyle around the insertions of popliteus and collateral ligament, and screw it after obtaining a good balance of the knee with the displacement of the osteotomized bone downward and/or posteriorly.

For group 2, which is characterized by medial collateral ligament instability, it is safer to treat these knees with a postero-stabilized more or less constrained prosthesis than using a PCL sparing one and advancement of the medial ligament.

For group 3, severe overcorrection in valgus after lateral closed osteotomy for tibia varus realizes an upper tibial malunion. Prosthesis implantation is difficult: difficulties of soft tissue balance, conflict between upper tibial lateral cortex and tibial metalback stem, and bad coverage or overlapping of the tibial metalback, unless using a twisted stem. Different options can be chosen:

postero-stabilized prosthesis needs a release of lateral side; the tibial cut perpendicular to mechanical axis resecting bone to the bottom of the lateral defect takes off a too big amount of bone on the medial tibial plateau to have a safe support for metal back. If bone graft of lateral plateau is done to avoid this fact a constrained insert is potentially necessary.

Implantation of a PCL sparing prosthesis with also release of lateral soft tissue, and reconstruction of medial tibial plateau and eventually condylar bone loss. For stability of the knee PCL acts as a collateral ligament.

correction of the deformity by a new tibial osteotomy and after its consolidation implantation of the prosthesis some months later.

tibial osteotomy and prosthesis can be performed during the same operation, using a long tibial stem, cemented or not to stabilize the osteotomy site.

3) FLEXION CONTRACTURE

Correction of the deformity can be difficult when flexion is more than 30 or 40 degrees; PCL is not always an obstacle for correction. Sometimes initially anterior bony deformity of the upper tibia has to be resected, especially in rheumatoid arthritis. After regular cut of the distal femur and removing of posterior osteophytes and loose bodies, elevation of posterior capsule from the distal femur is less dangerous than transverse incision of its middle part. If needed proximal attachments of gastrocnemius can also be stripped from the femur. Then if knee extension is not possible with trial component the tightened PCL has to be sacrificed, or released or lengthened for some surgeons wanting to spare it. Finally a choice between

lengthening of hamstrings and pes anserinus or a new cut of distal femur is necessary with use in some cases of a more constrained tibial plateau. For good tracking of patella lateral retinacular release is also mandatory.

4) FLESSUM, RECURVATUM, MALROTATION

Small flessum or recurvatum in metaphyseal area can be managed with the femoral anterior and posterior distal femoral cuts or tibial cut with sometimes incidence on prosthesis choice and biomechanical consequences.

Malrotation around 15 degrees can also be corrected by implants positioning, and perhaps a little more than 15° using a mobile bearing prosthesis.

EXTRA ARTICULAR OR COMBINED DEFORMITIES

In this type of deformity it can be necessary to perform in the same or in two separate operations its correction by a diaphyseal osteotomy preferably at the site of the deformity.

It is mandatory to have a good fixation of the bone to allow a quick and strong rehabilitation of the knee after prosthesis implantation. Plating, nailing or stabilization by the stem of prosthesis can be used.

At the present time the trend is to reach good correction of the deformity and implantation of the prosthesis at the same time even if the deformity is extra-articular; this challenge can be difficult.

L15

LATE OUTCOMES IN KR

Navarro Quilis, A.

Hospital de Traumatología Vall d'Hebron. Universidad Autónoma de Barcelona
Barcelona, Spain

The outcomes of any procedure in our clinical practice have to be looked upon in several ways:

- a. The benefit the individual obtains from the procedure, in respect to the quality of life or well being.
- b. All these gains, if they are produced, must have a cost inferior to the ones that had occurred if the operation had not been done: (medical and social costs).
- c. The changes observed in pain, mobility and stability of the joint before and after the operation.
- d. The changes in the individual functional state: what the patient can do in his normal life activities (walk, stairs, fasten shoes, personal wash-up, etc) and any needed help for a normal daily living.

e. Length of time the procedure will be holding the results, and the necessity of revision (survivorship), depending on the clinical state and the radiographic studies (migration, inclination, subsidence, lucent lines in the surfaces, etc).

The aspects on well-being and cost-benefit after the total knee replacement have changed for better in a parallel way to the improvement on the function of the knee joint and the function of the body as a whole. We have recently studied the first two (a and b) outcome measures with positive results, that compare well to the published ones.

In considering others aspects or measures of the outcomes, we agree with M. A. R. Freeman that the year 1980 could be the milestone for looking back and forth in the history of total knee replacement. Before 1980 the number of early failures was high, mainly due to sinkage and inclination of the tibial component, wear of the components, instability of the joint, and patello-femoral pain.

We did work on the design of a new method of fixation for the tibial plateau from 1980 to 1988, because of the many publications on bad results due to tibial loosening; our method of fixation was based in an intramedullary elastic, press-fit, stem, trying to avoid the fixation on the tibial surface, mainly because the trabecular bone was weak to stand the weight pressures, and because it was very difficult to cover all the surface of the tibia cut (the tibial not only differs in size but also in shape).

Following the introduction of the ligament tensor by Freeman and the use of the “gaps” technique by Insall, in order obtain hte proper ligament tension and equal flexion and extension spaces and proper joint alignment, the short-term results published made us think that the tibial plateau problems were due more to bad surgical technique, that to other causes; we, therefore left aside our work.

The functional results since then have shown little changes; we have not obtained more flexion or stability, and the patello femoral problems have not improved much. The different new designs have more to do with early wear of the polyethylene and consequent osteolysis and instability, than with function.

The challenges of the future, in order to get better outcomes are:

1. *To obtain better flexion.*
2. *To obtain a better patelar tracking.*
3. *To reduce the lucent lines around the prosthetic components.*

1 and 2 should be addressed with a better geometry of the components. Practically every design and every technique change the geometric arrangement, specially, of the distal femur.

We change the troncoconical (medial bigger than lateral) shape of the condyles into a cylindrical one; we change the oblique hinge into a normal

one; we do not allow space for the lateral condyle to run backwards and forwards on the lateral tibial plateau in flexion and extension. This last problem is made even worse by the tension of the lateral ligament in flexion of the knee.

If we had all this into consideration we could get more flexion and better patellar tracking. Actually, we are working on this subject.

The issue 3 on the radiolucent lines: the coating of hydroxiapatite might finally give a better fixation than cement. Hydroxiapatite resists the micromovements better and its interface membrane disappears in favour of bone.

L16

POLYETHYLENE WEAR IN TOTAL KNEE REPLACEMENT

Brach del Prever EM¹, Bracco P² and Costa L²

¹Università degli Studi di Torino, Dipartimento di Traumatologia, Ortopedia e Medicina del Lavoro - Centro Traumatologico Ortopedico, 1° Clinica Ortopedica, Via Zuretti, 29 – 10126 Torino (Italy), e-mail: elena.brach@cto.unito.it

²Università degli Studi di Torino, Dipartimento di Chimica IFM, Via Giuria, 7 – 10125 Torino (Italy)

Introduction – Polyethylene (PE), or better Ultra High Molecular Weight Polyethylene (UHMWPE) wear was demonstrated to be the main cause of Total Knee Replacement failure during the '90ties years. Wear, that occurred during the in vivo service, was related to the implant biomechanics, both the prosthetic design (constrained - non constrained, PCL sacrifice...) and the implant technique with rotational and alignment defects. In all these studies, retrieved PE inserts and wear particles were supposed to be UHMWPE, with the same chemical and physical characteristics of the original certified polymer. Unfortunately, degradation of UHMWPE, that is the modification of the chemical and physical structure, may occur during the preparation of prosthetic components; in particular, gamma irradiation in air is responsible for superficial and deep, unpredictable, inhomogeneous oxidative degradation of the polymeric biomaterial (1-6). Therefore, new PE components sterilised by in air gamma irradiation and ready for implant can be supposed to be UHMWPE, but they could not be. Sterilisation with ethylene oxide (EtO) does not modify the chemical and physical properties of the original PE. Furthermore, during the service in vivo cholesterol and other components of the synovial fluid diffuse in the PE components and modify the mechanical properties of the polymer (7).

Aim of the study - To characterise new PE components (hereafter called PEs in this paper) ready for implants and retrieved PEs obtained from failed total knee replacements in order to evaluate the wear, oxidation level and, in the retrieved ones,

the diffusion products after service in vivo. Only after this characterisation some mechanical considerations and therefore wear in vivo could be discussed.

Materials - 24 new and 75 retrieved PEs were analysed. New PEs were produced by 9 different firms, 18 were sterilised by gamma irradiation in air, 1 in inert atmosphere or in vacuum, 5 by EtO. Surgical revisions were performed after an average time of 5 years (min 3 months, max 15 years) because of aseptic loosening (51 cases), septic failure (16 cases), PE severe wear (4 cases), other causes (4 cases). The retrieved PEs had been produced by 15 different firms; 74 were sterilised by gamma irradiation, while only 1 by EtO. The mean age at revision was 70 years (range 57-82 years).

Methods – At the surgical revision, PEs were photographed; wear area score according to Collier and wear severity score according to Plante-Bordeneuve and Freeman were evaluated. Prior to the analyses, PEs were stored in the dark in formaldehyde 4%. New and retrieved PEs were cut perpendicularly to the articular surface. A series of slices of controlled thickness (from 100 to 300 microns) were recovered from the cross-section using a Poly Cuts Microtome (Reichert-Jung) at 20 mm s^{-1} in air at room temperature. A FTIR Microscope (Perkin Elmer System 2000) equipped with an x-y motorised micropositioning stage was used to identify and map the distribution and level of oxidation. Identification of oxidised species was carried out by derivatisation and IR analysis. Soxhlet extraction in boiling cyclohexane for 20 hours was performed to extract low molecular weight substances which diffused into PEs.

Results – All new PEs sterilised by gamma irradiation in air presented surface and bulk oxidation, variable in severity and distribution. Wear of retrieved PEs sterilised by gamma irradiation in air was extended for more than 50% of the articular surface (score 3) in 60% of cases and was severe (score 5-8) in 47% of them. In most of the gamma irradiated in air retrieved plateaux a “crown zone” at a depth of 1-2 mm from the surface was observed. This zone has been found to correspond to the maximum of the oxidation profile, measured by FTIR mapping. Diffusion of cholesterol and its esters with fatty acids has been observed in many of the samples, in variable amount depending both on the clinical situation of the patient and on the implant time.

Conclusions – These results show that significant modifications of the physical properties of UHMWPE can be introduced by the sterilisation treatment. The chain reactions that follow gamma ray sterilisation and lead to oxidation tends to decrease the molecular weight of UHMWPE. The presence of the subsurface “crown zone” is the macroscopic evidence of an extremely high level of oxidation, responsible for delamination and wear of the tibial plateaux. Critical mechanical phenomena can be related with oxidation due to gamma irradiation and in vivo degradation. Diffusion in the PEs of cholesterol and other synovial fluid components may affect the mechanical resistance in vivo. All these results emphasise that discussion about mechanical behaviour in vivo of different prostheses, particularly for total knee replacement where the biomechanics is complicate, must be proceeded by accurate control of physico-chemical properties of the ready-to-implant prosthesis and of the retrieved components. New tests must be introduced to control the integrity of the ready-to-

implant components, besides that of the raw material. Furthermore, suitable in vitro tests might give a prediction on the effects of diffusion on the material performances.

Bibliography

1. E.M. Brach del Prever, L.Costa, M.Crova, A.Dallera, P.Gallinaro, G.Camino. M.P.Luda: "Unacceptable biodegradation of UHMWPE in vivo" - Biomaterials 1996, 17, 873-878
2. L.Costa, MP. Luda, L.Trossarelli, EM. Brach del Prever, M.Crova, P. Gallinaro "Oxidation in Orthopaedic UHMWPE sterilized by gamma radiation and ethylene oxide" - Biomaterials 1998, 19: 659-668
3. L.Costa, MP.Luda, L.Trossarelli, EM. Brach del Prever, M.Crova, P. Gallinaro "In vivo UHMWPE biodegradation of retrieved prosthesis" - Biomaterials 1998, 19: 1371-1385
4. Costa L. & Brach del Prever E.M. UHMWPE for arthroplasty. Edizione Minerva Medica, Torino 2000
5. Premnath V, Harris WH, Jasty M, Merrill EW. ,Gamma sterilisation of UHMWPE articular implants: an analysis of the oxidation problem.,Biomaterials 1996; 17: 1741.
6. Kurtz S.M., Muratoglu O.K., Evans M., Edidin A.A. "Advances in the processing, sterilization, and crosslinking of UHMWPE for total joint arthroplasty", Biomaterials 2000, 20 1659.
7. Costa L, Bracco P, Brach del Prever E, Luda M.P Trossarelli L. Analysis of products diffused into UHMWPE prosthetic components in vivo. Biomaterials 2001; 22, 307

L17

INFECTED TKR

Hämäläinen M.

Oulu University Hospital, Oulu, Finland

Despite of improved operative technique, ultra-clean air in the operating theatre and systemically administered as well as in bone cement loaded antibiotics, septic complications after replacement arthroplasty of the knee still exist. Depending of the follow-up time in different reported series incidence vary from 0.5 to 5 per cent.

Classic clinical symptoms, painful, swollen knee joint, possibly fever, indicate to more accurate examinations.

Lesson to learn: No treatment before adequate diagnosis! No "homeostatic" antibiotics before accurate examinations. If the very first contact with physician or surgeon happens in such conditions, that adequate diagnostic methods are not available, patient has to be referred to hospital or institution with capable facilities.

Prosthetic infection can be classified in many ways. The following classification is useful for the treatment purposes.

Classification of infection:

1. Early postoperative infection less than 4 weeks after surgery.
 - a. superficial
 - b. deep
 - c. extensive soft tissue defects due to skin necrosis
2. Originally patient is operated for aseptic loosening, but intraoperative cultures are positive.
3. Late chronic infection.
4. Acute hematogenous infection.

Diagnostic methods:

1. Clinical examination:

- symptoms can be suppressed by painkillers or immunomodulant drugs
- wound healing problems
- sinuses
- swelling, redness
- pain
- temperature increased

2. Blood chemistry:

ESR, C-reactive protein and blood white cell count/ differentiation are helpful.

Be ware if the patient has such a general disease, which increases fex CRP

3. Routine x-rays. In early cases no significant signs, in late cases might appear erosions or cysts.

4. Isotope scintigraphy. Technetium- or indium labelled leucocytes are given intravenously.

The patient is scanned 24 hours. Extended scintigraphy seems to be more sensitive than routine 6 to 8 hours' scintigraphy.

5. Joint aspiration.

One has to sure, that the patient is not on antibiotics. If she/he is, antibiotics has to be stopped for two to four weeks, and aspiration performed after that, unless infection is not clinically obvious or situation is not life-threatening.

White cell count/differentiation can be for some help. When the cell count is less than 2000/ml, and majority of cells are mononuclear, the result is indicative negative for infection. White cell count over 10000/ml, and majority polymorphonuclear, speaks for infection.

When the aspiration has been carried in aseptic condition, positive culture is strong evidence for infection.

Adequate handling of sample is important: as little as possible air in the syringe and as short as possible time used for transportation to lab.

Treatment protocols

Treatment protocols can rather straight forward: if any sample culture is positive,

Two-stage revision arthroplasty is carried out. But also more conservative opinions are reported.

1.a. Early postoperative, superficial infection:

Surgical débridement of the wound.

Careful examination of retinaculum layer. Lavage and wound closure if possible. Systemic antibiotics. Joint puncture and aspiration through healthy skin area, never through open wound.

b. Early postoperative, deep infection:

Open débridement and careful lavage with retention of prosthesis. Additional preoperative samples for culture in order to confirm earlier pathogene definition.

Systemic antibiotics regarding sensitivity estimation. Arthroscopic débridement and lavage has not proved to be better or neither as good as open. New aspiration 4-6 days after. If white cell count clearly over 10000/ml and possibly culture positive, new débridement and lavage. If third débridement comes necessary, even without bony changes, removal of prosthesis and antibiotics-loaded spacer has to be considered.

c. Dehiscence of wound or soft tissue defect due to the necrosis:

Wound débrident, antibiotics and depending on the extend of defect either partial closure, skin grafting or pedicled gastrocnemius muscle flap is performed.

2. In some cases there is no signs of infection, and the is operated as an aseptic loosening. In all revision, routinely 4 to 5 tissue samples should be taken for culture. If preoperatively there is any doubt about infection, histological examination of frozen sections should be carried out. If there is high count of polymorphonuclear cells, results of culture has to be waited. If later on in minimum two samples same pathogen is growing, the case has to be considered as infected. Two-stage revision protocol is recommended.

One positive sample cannot be regarded as a concluding proof. Long-term antibiotics are recommended.

3. Late chronic infection has insidious, slowly progressing onset. Symptoms can be confusing mild, and can lead to misdiagnosis. Method of choice is débridement, removal of the prosthesis and all bone cement, and placement of an antibiotics-loaded cement spacer. No dead space is left, but has to be filled with antibiotic-loaded collagen or antibiotic-cement beads. The patient is put on systemic antibiotics, preferably combination of two. Antibiotic therapy is continued six- to eight weeks. Healing process is controlled with ESR and CRP tests. If the blood test normal and clinical situation is normal, delayed revision arthroplasty is performed. Antibiotic loaded-cement is always used.

4. Acute hematogenous infection. Onset is usually acute and symptoms dramatic.

Sometimes distant focus can be found. If the history is rather short (less than 14 days) open débridement, retainment of prosthesis, antibiotics-loaded collagen filling of the joint as well systemic antibiotics is recommended. Recovering is monitored by blood chemistry and repeated joint aspiration and cultures. If in aspiration sample there is high polymorphonuclear count and culture possibly positive, new débridement is carried out. If signs of infection still continue, two-stage exchange to be considered.

Pathogenes

Gram-positive staphylococci are most frequent pathogens in total knee replacement infections (95%). Gram-negative bacilli cover the rest (5%).

Coagulase-negative staphylococci has grown up the most important bacteria, and its resistance against antibiotics has turned frightening.

Spacers

In cases with short history retention of prosthesis can be considered. Many authors change of polyethylene bearing.

In two-stage revisions static antibiotic-loaded cement spacer was used during

The six to eight weeks' interval. Static spacer is connected with extensive bone loss as well as stiff causing problems in secondary revision. Molded cement spacer is used in order to avoid complications and to achieve better functional results.

Failure

In some cases treatment of infection is unsuccessful. Arthrodesis with method of Ilizarov or intramedullary nail or sometimes above-knee amputation comes necessary.

L18

REVISION TOTAL KNEE ARTHROPLASTY

Knahr K.

Orthopedic Hospital Vienna – Speising, Speisingerstrasse 109, A – 1130 Vienna, Austria.

Total knee arthroplasty is a predictable operation. Unfortunately, there is a subset of patients who do not well and require revision surgery. The surgical objective of revision total knee arthroplasty is the same as primary total knee arthroplasty: restore the original anatomy, restore function and provide a stable joint. The operation technique itself is a decisive for the success of arthroplasty as any type of malalignment may result in pain, instability or loosening of the implant.

1. REASONS OF FAILURE

The most important reason for revision total knee arthroplasty include aseptic loosening of one or both components. Early loosening occurs frequently as failures of ingrowths of a porous coated implant, while late loosening mainly concentrate on cemented components, predominantly the tibial part. Another major reason for knee arthroplasties to fail is instability between the femur and tibia, caused by incorrect alignment or laxity of the ligaments. Wear and osteolysis are the result of abnormally increased abrasion and plastic deformation of the polyethylene inlay. Usually this is a sequel of overloading through subluxation or deformity. It generally happens when the weight-bearing contact surfaces are small.

Pain around the patella may occur due to anterior displacement of the patellofemoral joint and is not related whether the patella remains natural or is totally replaced.

Rare complications are fatigue fractures of metallic components, femoral or tibial fractures around the implant, extreme limitation of motion or hyperextension of the joint.

The most severe complication is periprosthetic infection, which in most of the cases requires a one or two-stage revision procedure to replace the implant.

2. GOALS OF REVISION SURGERY

Correct axial and rotational alignment including the restoration of the right joint line is mandatory for the success of a revision total knee arthroplasty. Especially joint line elevation can result in functional disorders, therefore the use of distal femoral augmentation in revision has given more attention.

Balance of soft tissues to create equal flexion and extension spaces is another mandatory goal for revisions. Soft tissue releases can usually correct fixed angular deformities. Concerning balance by additional cuts of femoral or tibial bone one has to remember that adjustments on the femoral side can effect the knee in flexion or extension, whereas any adjustment on the tibial side will effect both. Minimize bone resection and achieving stability by stable fixation of all components of the implant are further prerequisites for the success of revision surgery.

Another criteria for success is correct patella tracking, which can on the one hand be solved by soft tissue procedures or by revising the implant. Even one has to change the femoral and tibial component, retaining a well-fixed patella component appears to be a suitable option.

One of the most important criteria in revision total knee arthroplasty is implant selection. Recent publications have demonstrated that the implant-related failure rate was 25% when using implants designed for primary total knee arthroplasty, the failure rate of modified primary components was 14% and if components were used specially designed for revision the implant-related failure rate dropped to 6%. It was evident that revision implants exhibited superior performance and durability despite their use in more difficult reconstructions.

Concerning wear and osteolysis one should consider that an isolated revision of an polyethylene insert should not be performed when there is accelerated wear of the insert with severe delamination and radiographically under surface osteolysis.

The major objectives of bone grafting or augmentation blocks are filling in bony defects with biomechanically stable components to allow weight bearing and functional motion, to create an equal flexion and extension space for ligamentous stability and to restore a nearly anatomic joint line.

The use of intramedullary stems at revision surgery provides fixation of components into diaphyseal bone leading to increased stability for reconstruction. It produces axial alignment, the stems also partially relieve stresses on the deficient metaphyseal bone or allograft.

3. TREATMENT OF INFECTION

The incidence of periprosthetic infections is rather low. In early infections antibiotic treatment combined with open arthrotomy including debridement and exchange of inlay are the treatments of choice.

Late infections are best-treated combining antibiotics and two stage exchange arthroplasty. Arthrodeses or amputations are extremely rare to indicate.

4. REVISIONS WITHOUT REPLACING THE IMPLANT

Many of these procedures belong to the patella including the removal of osteophytes, secondary release of the lateral patella retinaculum, secondary replacing the patella with an implant, or patellectomy.

The replacement of a worn tibial inlay is often combined with secondary synovectomy, sometimes heterotopic ossifications need to be removed for the improvement of mobility. In infected knees the placement of an inflow/outflow drain in an attempt to manage an acute periprosthetic infection or to provide relief of pain in the presence of sepsis.

L19

DISTAL RADIUS FRACTURES IN ADULTS

Goldie B.S.

Whipps Cross University Hospital, London E11 1NR, UK

My talk concentrates on the practical management of wrist fractures in adults. The management of complications of wrist fractures and the management of fractures in children are covered by other speakers.

Epidemiology

Fractures of the distal end of the radius have been estimated to account for upwards of 1/6 of all fractures seen and treated in emergency rooms. Distal radius fractures are more common in women. Above the age of 50 years, 86% of wrist fractures are in women. Fractures increase in incidence in both sexes with advancing age, and usually result from a fall from level ground rather than from high-energy trauma. 10% of adults older than 35 years will suffer a distal radius fracture in a 30-year period.

Historical

Up until the early 18th century, it was thought that the injury that resulted from a fall on the outstretched hand was a dislocation and not a fracture. The first author to suggest that the injury was a fracture was probably JL Petit in 1783. Abraham Colles published his article in 1814 without having dissected a specimen showing a fractured wrist. Barton described the fracture associated with his name in 1838. RW Smith described extra-articular bending fractures of the distal end of the radius in 1847.

Classification

There are very many different classifications used to describe fractures of the distal radius. The Frykman classification (1967) has been widely used in the past. It concentrates on the involvement of the radioulnar joint. The classification system of AO is useful for documenting fractures that does produce 144 possible combinations. The classification by Fernandez (In: Fractures of the Distal Radius Fernandez and Jupiter, Springer 1995) concentrates on the mechanism of the fracture and enables correlation with the management of the fracture. It is the most useful classification when deciding exactly what to do.

Imaging

Plain radiographs are the mainstay of fracture management. Good quality AP and lateral views are essential. A lateral view with the forearm angled 20 degrees towards the tube gives a better view of the lunate fossa. Tomograms can be used to evaluate the joint surface in an intra-articular fracture but has been superseded by more sophisticated imaging. Uni-planar CT produced good images in 1 plain only. The reconstructed images in second plane were always of poor quality. Nowadays Spiral CT produces excellent images with rapid acquisition and low radiation dosage. MRI scanning has its use in evaluating soft tissue injuries and also injuries to the bone that have not caused a fracture, such as a "bone bruise". Intraoperatively it is possible to arthroscope the wrist in order to guide fracture reduction. This should only be attempted by skilled wrist arthroscopists.

Anaesthesia

In the UK, haematoma blocks have become the standard method of anaesthesia in the emergency room when manipulating fractures of the wrist. The degree of anaesthesia is somewhat unpredictable and the failure to achieve a complete anaesthesia leads to poor reductions.

Intravenous regional anaesthetic (Biers block) used to being the main form of the anaesthesia in British emergency rooms. The technique requires two doctors and was going out of fashion even before the manufacturers of Prilocaine withdrew the preservative-free formulation generally used for Biers blocks.

Axillary block anaesthesia is commonly used in the operating room but is less so in the emergency room.

General Anaesthesia is my preference for patients undergoing more than just simple manipulation.

Operative techniques

Surgeons should not limit themselves to only performing one method of stabilisation. They should be able to perform all forms. They should plan surgery in advance and should have the facility to adopt an alternative technique intraoperatively should this prove necessary.

If a patient requires a manipulation in a proper operating theatre using anything other than a haematoma block anaesthetic, then K-wires should be inserted for most fractures. There are many ways of inserting K-wires but my preference is for Kapandji intrafocal pinning.

External fixation can be used for many types of intra-articular fractures using the

principle of ligamentotaxis. Most fixators are applied bridging the joint. If not put on with excessive distraction, stiffness is not usually a problem. McQueen has published on the application of nonbridging fixators which certainly has some clinical indications. In the older patient, the use of bone graft should always be considered to fill the defect left the following elevation of a fracture. The alternative is to use synthetic bone graft substitutes such as Biobon[®]. Sometimes it is necessary to combine external fixation with supplementary K-wires.

Internal fixation

The volar approach through the terminal part of the Henry approach is relatively straightforward with low morbidity. This is used to apply volar buttress plates.

The distal radius is approached dorsally through incisions between the extensor compartments. The routine application of dorsal plates is favoured by some. However there is considerable morbidity associated with even the modern low profile plates such as the Pi plate. Tendon rupture is a particular problem. The plate usually has to be removed once the fracture has united. An approach between the fourth and fifth extensor compartment is useful in elevating the lunate facet prior to K-wire or screw fixation. Limited internal fixation using cannulated screws is useful in stabilising major fracture fragments such as the radial styloid.

As with any other fracture, the management of distal radius fractures is determined by the biology of the patient, the configuration of the fracture and the ability of the surgeon. The biggest errors come from considering all distal radius fractures as one, or applying one management protocol to all fractures.

L20

MANAGEMENT OF COMPLICATION OF DISTAL RADIUS AND ULNA FRACTURES

Alexa Ovidiou

University of Medicine and Pharmacy Iași, Romania

Department of Orthopaedics and Trauma

Clinical Hospital of Emergencies

Complications of distal radius fractures range from 20 to 30% and are consequence of injury or of treatment. Management of these complications must be individualised and the multitude of proposal treatments prove that this problem is controversial. Complications may involve soft tissue (tendon, nerve, arterial or fascial complication, reflex symphatetic dystrophy) or bone and joint (malunion, nonunion, osteoarthritis). Tendon complications following distal radius fractures, range from minor adhesions to complete rupture. Peritendinous adhesions will become apparent after cast removal. Diagnosis is based on the limitation of the range of movement for individual fingers. This complication can be avoided with a proper cast technique allowing full range of

motion to the digits. Treatment consists of rehabilitation techniques and only rarely, in severe cases, operative tenolysis may be a treatment of choice. Tendons may be entrapped either in the fracture site or in the distal radioulnar joint. Most common tendon entrapment is for extensor carpi ulnaris and extensor digiti minimi. If early recognition is made, open reduction with freeing the tendon must be the choice. Late diagnosis will require more complex tenolysis procedures. Tendon rupture may occur at the time of injury due to sharp fracture fragments. Diagnosis is based on identification of functional loss and, whenever possible, primary tendon suture is recommended. If the diagnosis is late the treatment is free tendon graft or tendon transfer. The late rupture of extensor pollicis longus is the most common possibility. Since it is not related with comminution or displacement of fracture it is possible that an ischemic mechanism is involved. Solutions are free tendon graft or the transfer of extensor indicis proprius. Direct tendon repair is not recommended after few weeks.

Nerve complications. Careful neurological investigations demonstrated that nerve injuries associated with distal radius fractures are more common than it is believed. Median nerve is most frequently involved. Primary mechanisms of injury are: direct lesions due to fracture fragments, lesions related to forced manipulation and nonanatomical position of immobilization. Late injuries, occurring a long time after the fracture are more frequent and are related to carpal tunnel syndrome or paraneural adhesions. Carpal tunnel pressure could be measured and etiologic factors must be identified in order to establish the proper treatment, usually based on release of carpal tunnel. Ulnar and radial neuropathy are less common and treatment may vary from cast removal to release of Guyon's canal.

Vascular complications are uncommon, arise usually in relation with high-energy trauma and the treatment is complex, involving different speciality surgeons. Some authors presented rare cases of entrapment of vasculature structures or radial artery pseudoaneurysm after the use of a volar plate.

Compartment syndrome after distal radius fracture is rare and is likely to occur in young adults suffering a high-energy trauma. Clinical diagnosis is based on the classical 5 "P's" (pain, pallor, paresthesias, paralysis, and pulselessness) but treatment must start before all symptoms are present. Anytime when compartment syndrome is suspected, intracompartmental pressure must be measured. The treatment must start immediately and consist in removal of constrictive devices (bandage, cast) and fasciotomy. Indications for fasciotomy are intracompartmental pressure of 15-25mmHg in presence of clinical signs or over 25mmHg in absence of clinical signs. If there is doubt, it is better to perform an unnecessary fasciotomy than to wait until lesions become irreversible.

Reflex sympathetic dystrophy is described with many terms such as algodystrophy, causalgia, Sudeck's atrophy, shoulder-hand syndrome. Recently, the term *complex regional pain syndrome* was proposed to replace all the existing synonyms. Despite many theories, the pathogeny of this disease is uncertain. The diagnosis is mainly clinical, based on presence of pain, trophic changes (atrophy, stiffness, edema) and functional impairment but plain x-ray demonstrating osteopenia and bone

scintigraphy showing abnormal bone turnover may be helpful. Since the patogeny is unclear, the treatment is targeting the symptoms rather than the disease. Treatment must be individualized and may consist of: physical therapy of the hand, pain control with general or local drugs, corticosteroids, and symphatectomy. Prevention of reflex symphatetic dystrophy in the first days of a distal radial fracture is very important and includes: prevention of the oedema (elevation of the hand, early mobilization of fingers), decrease of pain, cast removal to relive pression, non-traumatic surgery.

Malunion is the most common complication of distal radius fracture and it usually occurs after close treatment. The malalignment may be extraarticular or it may involve the joint (radiocarpal or distal radioulnar joint). Axial shortening and dorsal or radial malalignment are the most common. Clinical signs are wrist pain, loss of grip strength, limitation of wrist mobility. Osteoarthritis is likely to develop in both types of malunions. For extraarticular nonunions osteotomy is usually the treatment of choice. Many types of osteotomies have been proposed but the most commonly used are opening wedge osteotomy and Watson osteotomy. Intraarticular malunion is more difficult to treat and many surgical solutions have been proposed: intraarticular osteotomy, bone resections (styloid, anterior or posterior rim, radiolunate or radioscapolunate limited arthrodesis, proximal row carpectomy, wrist denervation, wrist arthroplasty, total wrist arthrodesis). Salvage procedures on the distal radioulnar joint may be resection of distal cubitus (Darrach) or Sauve-Kapandji technique.

Nonunion is an extremely rare complication and is likely to occur in patients with multiple comorbid conditions such as diabetes, peripheral vascular disease or alcoholism. In most cases the initial treatment was close reduction and cast immobilization or external fixation. Diagnosis is based on the absence of radiographic signs of union at 6 months. Treatment must be individualized but basic options are reconstructive procedures or wrist arthrodesis. Reconstructive procedures consist of debridement of non-union site, realignment with distractor, plate and screw fixation and iliac crest bone grafting. Since the bone is of poor-quality, new implants providing fixation in orthogonal planes may be useful. Usually, malalignment is present, so some authors recommend to take in to consideration the possibility to associate reconstructive procedures with additional techniques such as: dividing brachioradialis tendon, incision of the dorsal or volar joint capsule or Darrach operation in presence of severe shortening of the radius. Wrist arthrodesis should be chosen when the distal fragment has less then 5 millimetres of subchondral bone supporting the articular surface.

L21

WRIST INJURIES AND SCAPHOID FRACTURES

Skowroński J.C.

Orthopaedic Department Medical Academy of Białystok, Poland

The major aim of this presentation is to introduce the complex medical procedure concerning wrist fractures, luxations and wrist ligaments injuries based up-to date literature and author's own experience. In scaphoid fractures the most common one – the diagnostic problems (proper X-ray projection, repete X-ray, CT, bone scan, e.t.c.) are presented as well as the right treatment based on the bone healing pathology (different vascular topography, fracture type e.t.c.). Also the medical procedure algorithm of the fresh scaphoid fractures (Herbert's screw, Matti-Russe method), prolonged union or pseudoarthroses (bone transplant according to Matti-Russe or Fisk-Fernandes) is suggested.

The treatment ways concerning lunar fractures (blood supply disorders and Kienböck disease), capitatum fractures (unstable fractures - open reposition + bone graft), triquetrum fracture (a mirror Bennet or ridge fracture), trapezoideum fracture, hamatum fracture (most common one – the hook) and posiforme fracture (usually coexists with other fractures) one also discussed based on clinical examples.

Due to the wrist ligaments injuries author presents the most common luxations and instabilities; the treatment of perilunar luxations, either quicke hand reposition or open repositions with simultaneous tunnel decompression is described. The wrist instabilities are presented mainly due to diagnostic problems. According to static instabilities (dissociations) the author compares static X-ray and a healthy wrist X-ray (three arcs estimation, interbone space asymmetry) while dynamic instabilities require forced position X-ray scans. The most common instabilities – VISI and DISI – are also presented from wrist biomechanical point of view.

L22

SUPRACONDYLAR FRACTURES OF THE HUMERUS

Joseph Schatzker M.D., B.Sc.,F.R.C.S.(C)

Non-operative treatment of supracondylar fractures of the humerus has almost always resulted in failure. Closed reduction followed by prolonged immobilization until union, may be associated with an acceptable X-ray but with unacceptable function because of marked stiffness. Traction and early motion preserves movement but the incongruity of the joint leads to instability, early post-traumatic arthritis and pain. Traction also requires prolonged hospital admission which is not possible in modern

health care settings. Attempts at early motion without reduction, the so-called “bag of bones treatment” leads to gross malunions, non-unions and poor function.

In order to function normally an elbow requires stability, a congruent articulation, freedom from pain, and a functional range of motion. After fracture one can achieve a normal elbow only after anatomic reduction fracture which is combined with absolutely stable fixation and early motion.

These fractures are classified according to the Comprehensive Classification into Types: A, B, and C, with their respective groups and subgroups, all arranged in an ascending order of severity. Once a surgeon classifies a fracture he gains insight into the associated problems in treating it. Classification thus helps in proper decision-making.

In young patients these fractures are usually the result of a high energy trauma. Although multifragmentary and at times open, these are fractures of normal bone and are therefore often amenable to secure fixation.

In the elderly the commonest mechanism is a slip and fall on to the point of the elbow. The olecranon is driven into the trochlea and splits the osteoporotic condyle of the humerus into a multitude of fragments. The resultant fractures are multifragmentary, displaced and often defy attempts at reduction and fixation.

When one is deciding on treatment the factors which must be considered are patient factors, the fracture factors, and the treatment factors. The most important factors are: the patients age and the degree of osteoporosis, the comminution and displacement of the fractures, the association of neurovascular injuries, and whether the fracture is open or closed.

An open reduction and internal fixation is best performed with the patient on the side with the injured elbow uppermost, or with the patient prone. The best surgical approach is posterior. Once the skin is incised one must isolate and protect the ulnar nerve. The fracture is exposed by carrying out an osteotomy of the olecranon. In elderly patients in whom prostheses might become the salvage, one should consider using a triceps splitting approach or a triceps peel as for an elbow arthroplasty.

Commence fixation with an anatomic reduction of the trochlear fragment to the capitellar fragment. If bone is missing than instead of lag screws one uses fully threaded screws to prevent the narrowing of the distal articulation. Once securely fixed, the articular complex is fixed to the metaphysis and shaft. The fixation is carried out with two plates which should be positioned at 90 degrees to each other to achieve the strongest biomechanical construct. The plates commonly used are the 3.5mm LCDCP plates or the 3.5mm reconstruction plates. The choice of one or the other plate depends on the fracture pattern and on the necessary contouring of the plates. The usual choice are two reconstruction plates one medially and one posteriorly contoured to fit the posterior aspect of the capitellum which is devoid of articular cartilage. Such fixation is particularly useful in distal fractures. If there is metaphyseal bone loss one should use at least one LCDCP since these are stronger than the reconstruction plates.

Post-operatively the elbow is immobilized in 120-150 degrees of extension and is elevated for 24-48 hours. Early active motion should commence no later than day three in order to regain a range of motion.

Delay in internal fixation beyond day 5 often leads to the formation of heterotopic bone with marked stiffness. If surgery is delayed the patient should receive Indocid to prevent heterotopic bone formation. If heterotopic bone develops and blocks motion it should be resected early. One should not delay until the alkaline phosphatase and the bone scans return to normal.

Supracondylar fractures in the elderly present special problems since they defy attempts at reduction and stable fixation. As a result many elderly patients, whether operated or not, end up with poor and painful elbow function. To prevent these therapeutic disasters recently primary total elbow arthroplasty has been used as a primary form of treatment. Bernard Morrey published encouraging early results of elderly patients with supracondylar fractures treated primarily with the semi-constrained Coonrad Morrey prosthesis. Since then this rationale has been adopted by a number of trauma centres and there are numerous multicentres trials underway to evaluate this form of treatment and place it in its proper perspective.

Open supracondylar fractures present a special problem. If they occur in young patients with good bone and if they are reconstructible, then after a thorough irrigation and debridement a primary open reduction and internal fixation should be carried out. If stable fixation is not possible one should carry out an open reduction and fixation of the articular component, and span the elbow with an external fixator. Once a stable and closed soft tissue envelope has been achieved one can carry out a delayed reconstruction of the metaphyseal component. This greatly reduced risks of infection. In elderly patients with osteoporotic bone this may not be possible as indicated. Every open fracture must be irrigated and debrided. Stable internal fixation greatly lessens the risk of infection. Because of poor bone mobilization of the joint in these patients must be delayed and the internal fixation often supplemented with external fixation to prevent fixation failure. A primary arthroplasty should not be considered because of the risk of sepsis.

In young patients with good bone with Type C1 and C2 fractures 80-90% of good functional results are to be expected. C3 fractures particularly if open and fractures in the elderly, except those treated with primary arthroplasty, lead to unsatisfactory outcomes.

L23

FRACTURES OF THE SHAFT OF THE HUMERUS

Pazzaglia U.E.

Orthopaedic Department University of Brescia, Spedali Civili, Brescia, Italy

This study is based on 286 consecutive fractures of the shaft of the humerus surgically treated in the Orthopaedic Department Spedali Civili, Brescia, from November 1996 to December 2001.

Fractures were classified accordingly to AO System.

A peculiar group was represented by 33 (11.5%) complex and multifragmental fractures, where the fracture involved either the shaft and the proximal metaphysis and epiphysis.

Fractures were always treated by plate and screws when a deficit of the radial nerve was present, in order to allow neurolysis or nervous graft.

Fractures without radial nerve lesion were treated either by plate or by endomedullary nail.

In the latter group two types of nail were used:

- rigid, reamed, Kuntscher nail inserted through the proximal epiphysis,

- elastic nail, type Marchetti-Vicenzi, inserted through a posterior, distal humeral approach.

Patients were evaluated with a follow-up of at least 1 year.

The rate of fracture consolidation was similar in the group 1 rigid nail (96.5%) and plate (96.9%), while lower in the group of elastic nail (89.1%).

Also time of consolidation and functional recovery was similar in the first two groups. Particular problems presented by the group of complex fractures required a differentiated post-surgical treatment, with plaster cast or orthopaedic devices used as adjuvant mode of immobilization. All except one of these cases consolidated in a larger lapse of time (mean 4.5 months) with the following functional results: 36.5% very good; 18.1% good; 9.1% fair; 36.3% poor. A selection of the technical solution adopted is presented.

L24

PROXIMAL HUMERAL FRACTURES

Zyto K. (PhD)

Department of Orthopaedics, Söder Hospital, Stockholm, Sweden

Proximal humeral fractures account for approximately 4-5% of all fractures seen in the emergency departments. Of all shoulder injuries they account for approximately 53%. In 1970 Neer published his classic study, in which he described a new method of

classification, and gave recommendations for treatment. Neer recommended ORIF for three-part fractures, and prosthetic replacement for four-part fractures and fracture-dislocations. However there is still disagreement on the management of the displaced humeral fractures.

Diagnosis

Accurate radiographic evaluation, is essential in order to make a correct classification of the proximal humeral fractures. The radiographic examination consists of films from three different views. The antero-posterior (AP), lateral (Y view of the scapula), and the axillary one. The AP view will assess the fracture position, and by centring it 30 degrees posteriorly and obliquely, clearly image the glenohumeral joint space. The lateral view is taken perpendicular to the scapular plain. The head overlaps the glenoid, and projects on the centre of a “Y“, formed by acromion, the coracoid superiorly, and the scapular body inferiorly. In this projection any large avulsed greater tuberosity fragments are usually easy to visualise posteriorly, and the lesser tuberosity is visualised medially.

The axillary view is the most useful in assessing the relationship between the humeral head and the glenoid. Fracture dislocations, and true posterior dislocations can be easily distinguished in the axial view. Computer tomography, plain or with three dimensional reconstruction-views might also help the surgeon to make an accurate diagnosis and in preoperative planning.

Classification

A valid classification system can be useful as a tool to select the optimal treatment. The system should be comprehensive enough to reflect the complex fracture pattern, and specific enough to allow an accurate diagnosis. The classification should be useful as a tool for identifying those fractures which should be operated upon.

In 1935, Codman proposed a new classification system based on four different anatomical fragments of the proximal humerus. The anatomical head, the greater tuberosity, the lesser tuberosity and the humeral shaft. Codman stressed that the musculotendinous cuff attachment to each fragment was of major significance to the fracture pattern.

In 1970 Neer further developed Codmans classification, stressing the importance of the biomechanical forces, and the degree of displacement for more complex fractures. When any of the four major segments is displaced over 1 cm or angulated more than 45 degrees, the fracture is considered to be displaced: **Group 1:** all fractures regardless of the level or number of fracture lines, in which NO segments are displaced. **Group 2:** a two-part fracture is one in which one fragment is displaced in reference to the other three fragments. **Group 3:** a three-part fracture is one in which two fragments are displaced in relationship to each other and the other two are undisplaced fragments, but the head remains in contact with the glenoid. **Group 4:** a four-part fracture is one in which all four fracture fragments are displaced; the articular surface of the head is out of contact with the glenoid and angulated either laterally, anteriorly,

posteriorly, inferiorly, or superiorly. Furthermore it is detached from both tuberosities. Neer has also emphasised the term **fracture dislocation**. It exists when the head is displaced outside the joint space rather than subluxated or rotated and there is, in addition, a fracture. The degree of displacement is directly related to the clinical outcome and the choice of treatment.

In the 1970's the AO group from Switzerland, emphasised the importance of the blood supply to the articular surface of the humeral head. Since the risk for avascular necrosis was high, they based their classification on the vascular anatomy of the proximal humerus. The system classified the fractures into three different categories:

Group A: Extra-articular, uni-focal fracture.

Group B: Partially extra-articular, bi-focal fracture.

Group C: Articular fracture.

Each group is sub-divided into three categories, from less to more serious lesions. This gave us 27 different sub-groups to analyse and interpret. The AO system is easy to use for the diaphyseal segments of the femur, tibia and humeral shaft, but applying it to the proximal humerus is confusing, and makes it more difficult to use than the Neer system. Consequently the AO classification system has not gained general acceptance among shoulder surgeons.

The reliability and the reproducibility of these classifications have been questioned. Unfortunately, we do not have a better classification system on hand and therefore the Neer system is still widely used.

Treatment

Many methods of treatment of proximal humeral fractures have been proposed during the past 50 years, creating a great deal of controversy and confusion. There are two main treatment options: Non-operative treatment and operative.

Conservative treatment

Approximately 80% of all proximal humeral fractures are non-displaced, or only minimally displaced, and the clinical outcome is satisfactory after conservative treatment. After some days of rest, early mobilisation with gentle physiotherapy is of great importance.

Operative treatment

Various types of osteosynthesis have been suggested. Semitubular straight or angulated plates, screws, Rush pins, external fixators, cerclage wires, tension band technique or K-wires with bone grafting have been used. The results reported range from excellent to poor. In cases of three- and four- part fractures, most authors have used open reduction with internal fixation. Because of poor bone quality, and a torn cuff, especially in elderly patients, osteosynthesis is not always the best choice. Hemiarthroplasty is reported to give an excellent outcome in many studies. In fracture dislocations, when closed reduction is not possible, the only way to restore the dislocated shoulder joint is to perform an open reduction and stabilise the fracture with an osteosynthesis implant, or replace the humeral head with a hemiarthroplasty.

Scoring systems for evaluation of the end results

There are two rating systems generally used. The Neer system from 1970 has been widely used in a number of studies, all over the world, and the Constant-Murley system from 1987 has been recommended for use in Europe. Neer's rating system from 1970 is used to assess shoulder function, after fractures, arthroplasty and dislocations. It is based on a 100 units scale, with points for pain (35), function (30), range of motion (25), and anatomy (10).

In 1987 Constant and Murley designed a European scoring system, claiming it to be applicable for measuring shoulder function regardless of diagnosis. This system is also based on a 100-point scale. The degree of pain, activities of daily living, strength, and active range of movement are assessed. The results are then related to gender, age and activity level of the patient.

Both systems have recently been questioned because of its low reliability. Confusion remains because different authors from the USA and Europe continue to use their own criteria for evaluation. Consequently, it is not unusual that the reported results after fracture treatment vary, depending on which rating system was used.

L25

RADIUS AND ULNA FRACTURES IN CHILDREN

Parsch K.
Stuttgart, Germany

Number one in frequency of all fractures in children is the distal forearm fracture. The most common *greenstick fracture* with minor or no dislocation is treated by short or long arm cast. Depending on the age 4 or six weeks of immobilization is sufficient.

Displaced fractures of the distal radius and ulna are treated by closed reduction under general anaesthesia or lighter forms of analgesia. Reduction is followed by fixation in the "Schede position" (flexion, ulnar abduction) with obligatory change of cast after 10-14 days. Healing can be expected after 6 weeks. As an alternative percutaneous pinning of the reduced fracture allows immobilization in a short arm cast and without the unpleasant flexion and ulnar abduction (Voto et al 1990, Mani et al 1993, Gibbons et al 1994, Choi et al 1959).

There is currently a prospective randomised study running organized by Mr Clarke from Southampton, to the advantages and disadvantages after use of pins or abstaining from them apparent risks.

For midshaft forearm fractures closed reduction and long arm cast immobilisation had been treatment of choice in the past. Remanipulation under anaesthesia because of lack of retention of both bone fractures have been common. Concerns came up mainly

in the age group above 10 years with a high rate of unsatisfactory results (Kay et al 1986). Plate fixation of both bones is a difficult procedure and causes damage to the interosseous membrane and can enhance rotatory deficits. In addition ugly scars are not unusual. Intramedullary nails seemed advantageous. (Amit et al 1985)

J.L. Morote and the *Spanish school of Sevilla* were the first to use a minimal invasive method of reduction and K-wire fixation of midshaft and proximal forearm fractures. (Perez-Sicilia et al 1977).

The *French group in Nancy and Metz* had the some years later and developed their elastic stable intramedullary system for forearm fractures Metaizeau 1988, Lascombes et al. 1990). A high rate of excellent outcomes and hardly any complications were observed.

Intramedullary fixation with elastic stable nails even permits immediate motion (Verstreken et al 1988).

The *surgical technique of Morote* using blunt-ended 1,6 to 1,8 mm K-wires is described in "Operative Technique in Orthopaedics and Trauma" (Parsch 1990). The results were confirmed by Kaye Wilkins (1996), Luhmann et al 1998, and Richter et al 1998

An unacceptable high *rate of complications* was seen in groups, who used pins, which were not buried, who removed pins to early and before consolidation or who had fixed only one bone (Cullen et al 1998, Shoemaker et al 1999).

We recommend the intramedullary system for all displaced forearm fractures of children above 6 years until closure of the growth plate.(Parsch 1990). The learning curve is short, the time of surgery an average of 40 minutes. The radiation exposure can be limited by the use of short impulse image intensifier. There is virtually no blood loss. With the learning curve more than 80 % can be fixed by closed means. Open reduction might be necessary in adolescents, or in delayed fracture care.

Postoperative immobilisation is a plaster shell or brace is used for 2 weeks, this is not obligatory. Postoperative infections have not been observed after this minimal invasive method. Skin irritations can be avoided by complete bending of the K-wire ends.

In unacceptable *malunion* after conservative treatment closed or open realignment of the fractures followed by intramedullary Morote pinning is the treatment of choice.

Refractures may happen with wires in place shortly or a long time after removal of the hardware. They are not associated to the system, but rather to the fact that some children are subject to repeated falls, liable to break an arm.

Acute **Monteggia fractures** have the radial head reduced conservatively, usually under general anaesthesia. (Bado 1967). The ulnar fracture is reduced and than fixed by intramedullary K-wires (Fowles et al 1983)

In late reconstruction of Monteggia lesions we prefer plate fixation of ulna osteotomy.

Literature:

Amit Y, Salai M, Chechick A, Blankstein A, Horowski H. (1985) Closed intramedullary nailing for the treatment of diaphyseal fractures in adolescence. *J Pediatr Orthop* 5: 143-146

Bado JL (1967) The Monteggia lesion. *Clin Orthop Rel Res* 50: 71-86

Choi KY, Chan WS, Lam TP, Cheng JCY (1995) Percutaneous Kirschner wire pinning of severely displaced radius fractures in children. *J Bone Joint Surg* 77-B: 797-801

Cullen MC, Roy DR, Giza E, Crawford AH (1998) Complications of intramedullary fixation of pediatric forearm fractures. *J Pediatr. Orthop* 18: 14-21

Fowles JV, Sliman N, Kassab MT (1983) The Monteggia lesion in children. Fractures of the ulna and dislocation of the radial head. *J Bone Joint Surg* 65 A: 1276-1282

Gibbons CLMH, Woods DA, Pailthorpe C, Carr AJ, Worlock P (1994) The management of isolated distal radius fractures in children. *J Pediatr Orthop* 14: 207-210

Kay S, Smith C, Oppenheim L (1986) Both bone midshaft forearm fractures in children. *J Pediatr Orthop* 6: 306-310

Lascombes P, Prevot J, Ligier N, Metaizeau JP, Poncelet T (1990) Elastic stable intramedullary nailing in forearm fractures in children; 85 cases. *J Pediatr Orthop* 10: 167-171

Luhmann SJ, Gordon JE, Schoenecker PL (1998) Intramedullary fixation of unstable both-bone forearm fractures in children *J Pediatr Orthop* 18: 451-456

Mani GV, Hui PW, Cheng JCY (1993) Translation of the radius in distal radial fractures of children. *J Bone Joint Surg* 75-B: 808-811

Metaizeau JP (1988) Ostéosynthèse chez l'enfant. Embrochâge centromédullaire élastique stable. Sauramps, Montpellier

Parsch K (1990) The Morote wiring in proximal and midshaft forearm fractures of the child. *Operat Orthop Trauma* 2: 245-255

Perez-Sizilia JE, Morote Jurado JL, Corbacho Girones JM, Hernandez Cabrera JA, Gonzalez Buendia R (1977) Osteosintesis percutanea en fracturas diafisarias de antebrazo en niños y adolescentes. *Rev Esp Cir Ost* 12: 321-334

Richter D, Ostermann PA, Ekkernkamp A, Muhr G, Hahn MP (1998) Elastic intramedullary nailing: a minimal invasive concept in the treatment of unstable forearm fractures in children. *J Pediatr Orthop* 18: 457-461

Shoemaker SD, Comstock CP, Mubarak SJ, Wenger DR, Chambers HG (1999) Intramedullary Kirschner wire fixation of open and unstable forearm fractures in children. *J Pediatr Orthop* 19: 329-337

Verstreken L, Delronge G, Lamoureux J (1988) Shaft forearm fractures in children: intramedullary nailing with immediate motion: a preliminary report. *J Pediatr Orthop* 8: 450-453

Voto SJ, Weiner DS, Leighly B (1990 a) Redisplacement after closed reduction of forearm fractures in children. *J Pediatr Orthop* 10: 79-84

Voto SJ, Weiner DS, Leighly B (1990 b) Use of pins and plaster in the treatment of unstable pediatric forearm fractures. *J Pediatr Orthop* 10: 85-89

Waseem M, Paton RW (1999) Percutaneous intramedullary elastic wiring of displaced diaphyseal forearm fractures in children. A modified technique. *Injury* 30: 21-24

Wilkins KE, O'Brien E (1996) Fractures of the radius and the ulna. In *Fractures in Children*. Editors: Rockwood CA, Wilkins KE, Beaty JH, Lippincott-Raven, Philadelphia, New York, 4th edition pp 451-651

L26

SUPRACONDYLAR FRACTURES IN CHILDREN

Hasler C.

Children's University Clinic of Basle, Pediatric Orthopaedics and Traumatology, Basle, Switzerland

Introduction: Closed reduction and percutaneous pinning techniques for displaced supracondylar fractures of the humerus in children have overcome disastrous ischemic complications and long inpatient treatment. Closed reduction of those highly unstable fractures and the demanding pin placement itself are potential sources of failure for the inexperienced reflected by the rate of cubitus varus which is still about 5 to 15% in recent series. Rotational primary and residual displacement has to be appreciated to prevent permanent cosmetic deformity. Malrotation is the major source of instability since bicolunar support is lost which allows the distal fragment to tilt.

Anatomy: The transverse section of the distal humerus is the key to all stability related problems faced in supracondylar fractures of the humerus in children. In the supracondylar region the radial and ulnar column are only connected by a thin bony wafer which results from the presence of the cubital and olecranon fossa. In case of a fracture. In case of a fracture rotation leads to decrease of bony contact and hence to instability.

Epidemiology: Elbow fractures account for 7-10% of all paediatric fractures whereof 80-90% are located at the distal humerus with 80% involvement of the supracondylar region. Most of the supracondylar fractures occur between ages 5 and 10 years.

Mechanism of injury: Fall from a height, usually from a household object in the age group <3 years or from a playground equipment in children > 4 years on the outstretched nondominant arm (indirect elbow trauma). 96% of all supracondylar fractures are extension type injuries. Open fractures, mostly grade 1, occur when the anterior spike of the proximal fragment pierces through the brachialis muscle and the skin of the cubital fossa. Their incidence is about 1-3% in major referral centres.

Differential diagnosis: Supracondylar fractures have to be differentiated from transcondylar fractures and dislocations of the elbow. In a supracondylar fracture the fracture line stays proximal to the distal humerus physis. If it runs across it, it is most likely a supracondylar fracture. Dislocations of the elbow typically after the age of 10 years.

Neurologic compromise: Fracture related peripheral neuropathies have an incidence of 10 to 17%. With rare exceptions concomitant nerve lesion recover spontaneously within a time range of 1 to 4 months. The rate of iatrogenic nerve injuries is 3%-16% with the ulnar nerve being the most susceptible due to inadvertent pinning. Despite a high recovery rate, they are a nuisance for the patients.

Vascular compromise: Early recognition of vascular compromise with subsequent reduction and fixation of the fracture and avoidance of extreme flexion at the elbow have decreased the incidence of ischemic complications. An initially absent radial pulse is found in up to 19% in displaced fractures. Closed reduction restores pulsation in about 80%. Patients with postreduction lack of pulse or poor capillary refill should undergo vascular revision. There is still controversy regarding the management of a post reduction pink, warm but pulse less hand with adequate capillary refill. Simple observation and conservative management leads to a favourable clinical outcome in most cases but cold intolerance or exercise induced ischemic symptoms is a potential sequel.

Treatment:

Undisplaced fractures: simple immobilisation e.g. collar and cuff

Incomplete displacement: in case of malrotation and/or age-related unacceptable extension (>20° in patients older than 6 years) closed reduction and pinning otherwise conservative management

Complete displacement: Attempt for closed reduction and percutaneous pinning. Irreducibility is found in up to 22%. Open reduction is most widely as a last resort.

Complications:

Infection

Occasionally, superficial infection after pinning occurs despite all preventive measure (wires left protruding through the skin should not be covered by plaster to prevent rubbing; pin care instruction for the parents; regular follow-up for pin site inspection)

Cubitus varus

Most common complication with an overall incidence of about 20%. As a malunion in the coronal plane it has no capacity for remodelling. Although this deformity is mainly a cosmetic problem and does not interfere with the range of motion, it may be a functional problem in some activities e.g. in apparatus gymnastics.

Malunion / Stiffness

Even after perfect reduction, lack of full extension is common and usually takes over 6 months to improve. Impaired range of motion may be prolonged or even persistent due to an underlying pathology. Malunion is the most common one. In the sagittal plane, antecurvation leads to hyperextension and reduced flexion of the elbow. Significant remodelling with growth can only be expected below the age of 6 and in antecurvations of less than 20°. Rotatory malunion with an anterior spur restrains flexion. Complete remodelling of the spur usually takes place even in older children. Volkmann's contracture represents the most severe complication after supracondylar fractures. Fortunately, it has become a rarity.

Conclusion:

The human factor, in view of the particular anatomy of the supracondylar region and the extreme fracture instability seems to be more decisive for the end result than any biomechanical differences of various pin configurations. Repeat instruction by an experienced surgeon for proper reduction technique, assessment of achieved reduction and technically correct pin placement is crucial to further improve the outcome of this challenging fracture.

L27

FRACTURE SEPARATION OF THE RADIUS IN CHILDREN

Cassiano Neves M., Telles Freitas R.

Department of Orthopaedics– Medical School of Lisbon, Portugal

Proximal Radius – Fractures of the proximal radius in children account for slightly more than 1% of all children's fractures, represent 5 to 10% of all elbow fractures and accounts for 5% of all fractures involving the growth plate. The average age in the literature is 10 years (4 to 16 years) with no difference between boys and girls.

The *anatomical aspects* should be emphasized for the comprehension of this fracture: 1) the radial head of the child only starts to ossify at age 5 so it is very rare to have a fracture before this age since all the head is cartilaginous and therefore more resistant to trauma. At the same time it makes more difficult the diagnosis because of the absence of ossification of the epiphysis. 2) There is a valgus angulation of 12.5° between the radial head and the shaft of the radius in the AP plan and an anterior angulation of 3° on the lateral plane that should not be misinterpreted as fractures. 3)

The radial head is intrarticular in a similar way like the femoral head and trauma to this region may lead to AVN as a result of damage to the vascular supply of the epiphysis. 4) The proximal radioulnar joint has a very intimate continuity contributing to exact congruence of the articular surfaces. The axis of rotation lies directly in the centre of the radial neck. Any deviation of the epiphysis over the neck has a major reflect over the axis of rotation causing a “cam” effect when the radial head rotates with loss of prono-supination.

The *mechanism of injury* responsible for this injury result from a fall on the outstretched upper extremity in which the elbow is extended and a valgus force is applied to the elbow joint. In more rare cases it result from direct pressure to the radial head during dislocation of the elbow.

There are different *classifications* mostly based on the anatomical lesion or degree of deformity. Wilkins divides this fracture in two major groups: Group I (valgus fracture) subdivided in three types: type A – the Salter-Harris type I and II, type B – Salter-Harris type IV and type C – fractures involving only the proximal radial metaphysis and Group II (fractures associated with elbow dislocation) subdivided in two types: type D – reduction injuries and type E – dislocation injuries. O’Brien divides the common valgus injury in three types according to the degree of angulation between the radial head and the axis of the radius: Type I (0 to 30° angulation) Type II (between 30° and 60°) and Type III (more than 60°).

The *clinical symptoms* may vary according to the magnitude of the injury. The child will mostly complaint of pain and tenderness on the lateral side of the joint. In young children pain may first be referred to the wrist. The pain usually increases with prono-supination and extension of the elbow.

The *diagnosis* relies mostly on the x-ray view (AP and lateral) and the fracture will be easily visualized in either film. In the cases where the fracture line is superimposed over the ulna an oblique view will be necessary. In the young child, whereas the epiphysis is still not ossified, an ultrasound may be helpful differentiating the position of the radial head. An arthrogram may also be of benefit especially during the process of reduction to check the accuracy of the treatment.

The *prognosis* of this lesion depends on several factors. A poor result can be expected if the fracture is associated with other injuries such as elbow dislocation and ulna or medial epicondylar fractures. A residual tilt of the radial head, provided is not superior to 30°, is more tolerable than a translocation of the radial head superior to 4mm. Age is also an important factor since the older the child the less remodeling it will have. The treatment has also an important role in the prognosis of this injury since it is unanimous acceptable that an open reduction is associated with poor results.

Therefore the *treatment* of a young child with an isolated minimal displaced fracture-separation of the proximal radius (less than 30°) should be a simple long arm cast. In a more displaced fracture (more than 30° of tilt) a closed reduction should be performed under general anesthesia as suggested by Patterson. If the manoeuvre is not successful other attempts should be made with lateral pin compression applied directly to the radial head as suggested by Pesudo or an indirect reduction by an intramedullary

Kirschner wire as suggested by Metaizeau. Open reduction should be only reserved for dislocated Grade IV Salter-Harris type fractures, incarcerated radial head or in the presence of failure of closed treatment.

The incidence of *complications* especially if associated with a dislocation of the elbow or other fractures can be high. The most common are loss of motion, radial head overgrowth usually with no clinical significance, notching of the radial neck and premature physal closure. Avascular necrosis of the radial head is most commonly associated with open reduction.

Distal Radius – It is the most common fracture separation in children and represent 46% of all fractures involving the growth plate. A fracture of the ulna is associated in 6 to 11% of the injuries. The average age is 12 years with a minimum of 7 and a maximum of 16 years. Although this high incidence it is very uncommon subsequent growth disturbance.

The usual *mechanism of injury* is similar to the proximal radius injury and result from a fall on the outstretched upper extremity with the wrist hyperextended.

This type of injury is *classified* by the Salter-Harris classification for physal fractures and the most commons are the types I and II.

The *clinical symptoms* vary from mild tenderness over the fracture site to a noticeable deformity most often with the apex volar. Attention should be given to the possibility of vascular and neural injury associated, mostly from the time of the acute deformation, and the *diagnosis* is made by x-ray view (AP and lateral) with the fracture well visualized.

The *prognosis* is in general good since even in the presence of a markedly displaced fracture it can be expected a remarkably remodeling even in an older child.

Treatment in a nondisplaced fracture only requires a below elbow cast for 4 weeks. In a displaced fracture a closed reduction should be performed under hematoma block or general anesthesia (in a young child). The reduction is stable most of the times in a plaster with the wrist in slight flexion. The incidence of *complications* is very rare.

L28

LONG-TERM RESULTS OF THE ACETABULOPLASTY IN CHILDREN WITH ACETABULAR DYSPLASIA

Wolter J.-Chr. , Wolf G., Graßhoff H.

Department for Orthopaedics of the Otto-von-Guericke-University, Leipziger Str. 44, Magdeburg, Germany

For the treatment of the acetabular dysplasia in the early childhood the spherical periacetabular osteotomy of the ilium is a well-recognized procedure.

52 hips of 35 patients treated with a periacetabular osteotomy between 1969 and 1985 we followed-up after 14 to 31 years. At the time of operation the average age was 2,8 years.

The measurement of the antero-posterior radiographs showed a normalization of the acetabular roof obliquity in 79% of the cases. However, there were only 46% of the cases with a normal centre-edge angle. 42% had a medium pathologic angle of 20 to 30 °. In 12 % we saw severe pathology with angles smaller than 20.

Fife cases (10%) presented radiologic signs of osteoarthritis and three a slight incongruence between head and acetabulum.

Rare cases of postoperative complications are presented.

The low incidence of radiographic osteoarthritis supports the view that the spherical periacetabular osteotomy is an appropriate surgical procedure to treat acetabular dysplasia in early childhood.

L29

LATE RESULTS OF OPERATIVE TREATMENT OF DDH USING DEGA'S TRANSILIAL ACETABULAR OSTEOTOMY

Synder M., Domzalski M., Grzegorzewski A.

Clinic of Orthopaedics Medical University of Łódź, Poland

Introduction: Thanks to early ultrasound diagnosis of DDH the number of late diagnosed cases decreased in the last ten years. The surgical intervention because of dislocated hip is also reduced to the few cases a year. We still however have in our practice patients after operative treatment of DDH. One of the methods used for proper hip reduction is transiliacal pelvic osteotomy described by Dega.

The aim of this study is to evaluate the late results of one stage procedure with Dega transiliacal pelvic osteotomy in the treatment of DDH with dislocation.

Material and Methods: In our Institution 256 dislocated hips were treated surgically by means of open hip reduction, femoral directional osteotomy and Dega's transiliacal osteotomy. From this group 102 patients (91 female and 11 male), presented 144 operated hips were seen for the final follow-up. The left hip was affected in 45 cases, right in 17, and bilateral in 41 patients. The mean age at the surgery was 23,5 months. Mean follow-up was 19.8 years (minimum 15 years after surgery). Patients were evaluated clinically (Barrett modification of McKay classification) and radiologically using Severin classification. All radiograms from whole period of treatment were collected and evaluated.

Results: In 90 hips the final result was classify as very good (57%), good in 36 hips (23%), satisfactory in 10 hips and poor in 8 hips. Radiologically very good result (group IA) was seen in 51 hips, good in 65 hips (group IB, IIA, IIB), satisfactory in 24

hips and poor in 4 hips. It was a good correlation between clinical and radiographic classification.

Conclusions: The late results after one stage hip reconstruction with Dega's transiliacal osteotomy gives long lasting good results and is recommended for operative treatment of DDH with dislocation.

L30

INDICATIONS AND RESULTS OF TOTAL HIP PROSTHESES IN DYSPLASTIC COXARTHROSIS

Makai F., Jančík I., Maresch P.

1. University Department of Orthopaedics Bratislava, Slovakia

Aim of the study: In our work we firstly investigated severe, neglected cases of dysplastic coxarthroses, secondly trying to elucidate the best type of implant and operative procedure for severe, neglected cases and find out the outcome of these operations.

Material and methods: In the period 1987-2001 we operated more than 700 patients with dysplastic coxarthroses, in whom we implanted total hip prostheses (THP's). The percentage of dysplastic coxarthroses among our hipoperated patients oscillated in the mentioned period between 40-50%, the average age of the mostly female patients was 38,8-42 years. In these mostly young patients we implanted following types of uncemented THP's; in the order of most operations: Zweymuller's cementless THP's, Aldinger's individual, custom made cementless THP's, the Harris-Galante cup and Geradschaft femoral stem, mostly uncemented, the C-Fit THP, rarely other types (f.i. Charnley's cemented THP's).

Results: According to evaluation of Merle d'Aubigne and Postel we achieved best results with Aldinger's custom made THP's – nearly 88% very good and good results.

Conclusion: The best long-term results in THP's for dysplastic coxarthroses were achieved by Aldinger's THP's, followed by Zweymuller's cementless THP's, which we consider as methods of choice in the mentioned cases.

L31

TOTAL HIP ATHROPLASTY WITH UNCEMENTED CLS SPOTORNO STEM FOR DYSPLASTIC OR CONGENITALLY DISLOCATED HIPS IN ADULTS: A LONG-TERM FOLLOW UP STUDY

Stafilas K.S, Kitsoulis P.B, Xenakis Th.A, Soucacos P.N,
Orthopaedic Department, University Hospital of Ioannina, Ioannina, Greece

INTRODUCTION: The treatment of “congenital hip disease” by total hip arthroplasty is now well established, but the indications for this type of surgery, the preoperative planning, the selection of the stem and the technique to be followed are still open to debate.

AIM OF THE STUDY: The purpose of this study is to analyse the long-term follow up after use of the cementless-system (CLS) femoral component designed by Spotorno in dysplastic or congenitally dislocated hips.

MATERIAL AND METHODS: Our study includes 70 hips in 59 patients, 49 females and 10 males, 36 left hips and 34 right hips that treated with total hip arthroplasty from 1987 to 2000. The mean age of the patients was 48.5 years (range 34-74 years). Forty-one hips were congenitally dislocated and twenty-nine were severe dysplastic. Preoperative planning with CT and CAD-CAE system were used for selection of the stem. 11 patients had bilateral total hip arthroplasties with Spotorno CLS stem.

RESULTS: The mean follow up was 8.1 years (range 2-14 years). No patients were lost during the follow-up period. Patients were evaluated clinically with Merle d’ Aubigne and Postel hip score. There was a significant postoperative clinical improvement of the mean pain score by 3.7 points, of walking ability by 2.2 points and of motion by 2,6 points. Thigh pain was not reported. There were no deep infections or mechanical loosening that required revision of the femoral component.

CONCLUSIONS: Although, the femoral component Spotorno CLS is used to every kind of hip diseases, had excellent long-term clinical results in adults, with dysplasia or congenital hip dislocation. Spotorno CLS uncemented femoral component represents an attractive option for adults with “congenital hip disease”.

L32

RM CUPS IN PATIENTS WITH ACETABULAR DYSPLASIA

Kuropatkin G.V., Sedova O.N., Eltsev U.P.

Orthopaedic Surgery Department of Samara Regional Hospital, Russia

The Acetabular Dysplasia creates serious technical problems for the insertion of acetabular socket. In first, cup must have a good primary stable fixation in a shallow acetabulum. In second, smaller cups are usually required in dysplasia hip, but small sockets must have thick polyethylene wall. And in third, cup design must ensuring easy reconstruction of the anterolateral bone defect. In our opinion, all these problems can be achieved by using of cementless acetabular Robert Mathys (RM) cups.

Materials and Methods

In the period from 1996 to 2000 168 patients with acetabular dysplasia were operated with titanium powder coated RM cups. The patients' age was from 18 to 75 years old (average 43,5). In 77 patients with type I dysplasia (AAOS classification) a primary stable fixation of the acetabular component in a good position without of filling bone defect was achieved. In 53 patients with type II dysplasia stable fixation was supplemented by closing of a cup by filler bone grafts in a place of bone defect. In case of type III dysplasia (38 patients) with very shallow acetabulum and extensive bone defects initial stabilization was achieved by the press-fit one or two anchoring pegs and insertion cancellous screws. In type III dysplasia the massive bone transplant was fixed by additional screws. The features of a design of a cup allowed to stop on the small socket sizes without danger of use implant with critically thin polyethylene wall. It considerably improved a covering of a cup.

Results

In 166 patients (98,8 %) a good medium-term results (2-6 years) were obtained. The radiologic controls have shown that the prostheses underwent good osteointegration. 2 patients (1,2%) needed revision. Of them one patient had a infected complication, one other had an aseptic necrosis of acetabulum and secondary cup migration. In all other patients no osteolysis was observed. The good primary fixation of the RM cup decreased the risk of aseptic loosening of the autologous bone graft. The temporal partial (not more than 1/3) bone graft resorption was found in 33,9 % at the type II and 42,1 % at the type III dysplasia. After 2 years in all cases we observed improvement of the bone stock quality at the site of bone grafting.

Conclusions

The features of a design of RM cup allow to use implants of the small size. The application for cup fixation pegs and screws allows to receive its reliable primary stability even at expressed acetabular dysplasia. The good primary stability and ease of application of bone grafts allows to achieve with RM cup of an overall objective of operation - maximal restoration of anatomy and biomechanics of the dysplastic hip joint.

L33

THE VALUE OF HIGH TIBIAL OSTEOTOMY IN THE TREATMENT OF KNEE ARTHRITIS

Synder M., Marciniak M., Drobniewski M.
Clinic of Orthopaedics Medical University of Łódź

Introduction: The knee arthritis is a very common seen chronic disease in an orthopaedic practice. It is mostly seen in patients after 6 decade of life and connected with a severe knee pain. In most of the cases the surgical intervention is indicated because of unicondylar arthritis changes. Because of the costs of the hemiarthroplasty we choose a high tibial osteotomy for tibial axis correction to prevent further gonarthrosis.

The aim of this study was to evaluate the late results after high tibial osteotomy in patients with unicondylar gonarthrosis.

Material and Methods: In our Institution during last 20 years 94 high tibial osteotomies were performed because of unicondylar, medial gonarthrosis. The mean age of the patient at the time of surgery was 56 years (from 19 to 72 years). The mean follow-up was 16 years. Only patients with arthritic changes on the medial compartment of the knee with a "good" lateral part of the knee were scheduled for this type of surgery. In every case the dome type of osteotomy was performed followed by 1cm resection of fibula. After surgery the limb was stabilized with plate in 16 cases, K-wires in 4 cases, Ilizarov frame in 43 cases, orthofix device in 8 cases and other type of external fixator in remaining 23 cases. In patients where external fixator was used the full weight bearing was recommended as soon as patient tolerated the pain. The external fixator was removed after an average period of 6 weeks when bone callus was diagnosed. To assess of the clinical results based on HSS score and radiological results were evaluated using the modified Dihlmann classification.

Results: In 88,8% of all cases the final result was graded as excellent and good, in 1,9% the final results was satisfactory and in 7.8% the final results was poor. From analyzed patients 46% was scheduled for TKR at an average time of 12 years after initial surgical procedure. In 28% after average 16 years after high tibial osteotomy the good shape of the knee joint was observed with good clinical function and radiographic appearance. Pain was reduced in 82% of all cases, increased range of the knee motion was observed in 65% and improved walking ability in 64% of all cases. The poor results were connected with not adequate patients selection for this type of surgery (patients after 7 decade of life) and with advanced arthritic knee changes before the surgery.

Conclusions: The high tibial osteotomy is a good method for preventing gonarthrosis. When early performed gives good long-lasting result. In our opinion is recommended for unicondylar gonarthrosis as an alternative to the knee hemiarthroplasty.

L34

IS UNICOMPARTMENTAL KNEE ARTHROPLASTY CONTRAINDICATED IN YOUNG ACTIVE PATIENTS?

Pandit H., Price A.J., Rees J., Beard D.J., Gill, H.S., Murray D.W., Dodd C.A.F.
Nuffield Orthopaedic Centre, Oxford, U.K.

Introduction: The indications for unicompartmental knee arthroplasty (UKA) can be contentious. Concerns exist about implanting a UKA in younger individuals and it has been reported that the procedure is contra-indicated in patients under the age of 60. The suggestion is that younger patients may compromise their outcome after surgery by their increased activity levels. However, the number of publications with data on UKA in young patients is minimal and the age/activity related criteria for UKA remains unknown.

Aim: The aim is twofold: 1) to confirm that younger UKA patients have higher activity levels than older patients, and 2) to test the hypothesis that younger, more active patients have inferior outcome when compared to older less active patients.

Materials and methods: Fifty consecutive patients undergoing UKA who were under 60 years old at the time of surgery (Group Y) and 50 patients over 60 years (Group O) were recruited. Indications were anteromedial arthritis with full thickness lateral compartment cartilage, a functioning ACL and a correctible varus deformity. All patients underwent Oxford UKA using the minimally invasive technique. This device employs an unconstrained fully congruous meniscal bearing. Outcome was evaluated using the American Knee Society Score (AKSS). Activity level was documented using the established Tegner Activity Score.

Results: The average age of patients for group Y and O was 55 years and 68 years respectively. Minimum follow up for both groups was 2 years. Pre-operative AKSS scores were comparable for each group (Group Y = 38.8, Group O = 35.8) and patients in both groups significantly improved after surgery. A significant difference in Tegner score was found between groups after surgery (Group Y = 3.9, Group O = 2.6). It was found that 40% of younger patients regularly participate in high demand activities like skiing, tennis, hard manual labour and swimming. No statistically significant difference in any other post operative knee scores or complication rate were found despite adequate study power.

Conclusions: Younger patients have increased activity levels after UKA when compared to an older age group. There is no evidence that the outcome of UKA in younger more active patients will be inferior to those who are older and more sedentary.

L35

CLINICAL OUTCOME AFTER REVISION OF UNICONDYLAR PROSTHESIS TO TOTAL KNEE PROSTHESIS

Becker R., John M., Neumann W.

Department of Orthopaedic Surgery, Otto-von-Guericke University Magdeburg
Leipziger Str. 44, 39120 Magdeburg, Germany

One of the advantages in using unicondylar prosthesis seems to be the preservation of the bone stock, which allows most often easily revision to a total knee replacement if required. The purpose of the study was to compare the patients' outcome after revision of unicondylar prosthesis with a group of patients who have received total knee replacement primarily.

Material and Method: 28 patients after revision unicondylar prosthesis (group A) and 28 patients after primary total knee replacement (group B) were included in the study. The two groups were matched according to age, sex, weight, height, type of prosthesis and follow-up time. The patients' evaluation was based on the Knee-Society-Score and the WOMAC-score. X-rays of the knee were taken in the AP weight bearing and lateral view.

Results: In group A the average follow-up time was 55 ± 15 months and in group B 56 ± 13 months. The knee-score showed 71.8 ± 18 and 80.4 ± 10.4 points and the function-score 56.1 ± 15 and 62 ± 19 points for group A and group B respectively without any statistical difference. The subjective assessment according to the WOMAC score showed difference in the functional outcome. A better range of motion of $110 \pm 11^\circ$ was noticed for group B in comparison with group A $102 \pm 8^\circ$ ($p=0.004$). The revised patients required a significantly higher polyethylene-inlay ($12.9 \pm 3\text{mm}$) compared to the primarily implanted ones ($10.3 \pm 3\text{mm}$) ($p=0.004$).

Discussion: Based on our findings revision of unicondylar to total knee replacement provides comparable results to primarily implanted total knee arthroplasty and should be considered for the treatment of unicompartmental osteoarthritis even in younger patients, where a revision operation during lifetime is more likely. Despite the difference regarding the height of the inlay of 3mm, adequate bone stock was still found in order to implant an unconstrained type of knee prosthesis. The impaired functional outcome seems to be related to the fact of the reoperation and a significant longer history of osteoarthritis for group A in comparison with group B.

L36

MANAGEMENT OPTIONS OF BONE DEFECTS IN REVISION TOTAL KNEE ARTHROPLASTY

Than P, Szabó Gy, Kránicz J, Bellyei Á.

Department of Orthopedics, University of Sciences of Pécs Medical School, Pécs, Hungary

Introduction: With the growing number of primary knee arthroplasties, the number of revision operations is also increasing. The large number of unicondylar replacements carried out in the 1980's, due to lack of modern total condylar implants, grant the revision techniques an outstanding significance in Hungary. One of the main issues of modern revision techniques is the management of bone defects, which can be solved by different methods documented in literature.

Aim of study: The aim of our study was to investigate the success and feasibility of the various defect management techniques by evaluating the results of revision knee prosthetic surgeries carried out at our clinic.

Patients and methods: Femoral and tibial bone defects had to be solved with revision surgeries in 35 cases, all performed due to aseptic loosening of uni- and total condylar prostheses implanted earlier. For filling of bone defects, metal augmentation of the prostheses was applied in 9 cases, allografts from bone bank were used in 11 cases, own cancellous bone was applied in 20 cases. Results were prospectively analysed with the help of the knee society rating system, with an average follow-up of two and a half years.

Results: Revision interventions were successful in 34 cases, detailed results are revealed in the presentation, complemented with case presentations. In a single case, repeated intervention surgery is indicated due to disorganisation of the structural allograft and the resulting loosening of the tibial component.

Conclusion: The success of the various bone replacement techniques, completed with adequate indication could be proven in all cases. The unsuccessful case proved that allograft incorporation should be supported by appropriate stem augmentation of the tibial component. In order to perform successful revision knee arthroplasty, we consider it fundamentally important to have a wide variety of allografts from bone bank and a modern knee prostheses system application already during primary implantations.

L37

ARTHRODESIS OF KNEE WITH INTRAMEDULLARY NAIL “WICHITA”. MULTICENTRIC PROSPECTIVE- RETROSPECTIVE STUDY.

Gutiérrez Carrera JM.¹, Ruiz Valdivieso T.¹, Sota Arce R.², Ginés Cespedosa A.³, Ganso Pérez A.⁴

(¹)Hospital Clínico Universitario-Valladolid, ²Hospital Marqués de Valdecilla-Santander, ³Hospital Universitari del Mar-Barcelona, ⁴Hospital Universitario Río Hortega-Valladolid, Spain

Knee arthrodesis is a useful procedure in difficult cases such as failed total knee arthroplasty, bone tumors and infected knee joints. A review of 27 cases treated using a modular locked intramedullary nail “Wichita” in 4 hospitals was performed. This fusion nail is a device designed to provide simultaneous compression and intramedullary fixation. The device is implanted through a single knee incision using three main components after femoral and tibial reaming. The femoral component inserts retrograde and has two holes in its proximal end to accept transverse locking screws. The tibial component inserts anterograde into the proximal tibia and has some holes for transverse screw placement. The compression screw component is used to lock the femoral and tibial components together and simultaneously compression is generated across the joint line. Theoretical advantages are single incision, immediate and solid stability, possibility of compression, adjust of length, high fusion rates and less risk of infection than other procedures. An individual study protocol was made and it includes previous primary or revision failed total knee replacement, severe articular trauma and infection. No bone tumors were included. Protocol includes aspects such as operative time and blood loss, intraoperative complications, radiographic evaluation (tibiofemoral alignment, contact tibiofemoral surface area...) shortening of extremity, time to union, postoperative complications and patient subjective evaluation. 10 patients are being studied prospectively in our institution since January 2000 and the mean follow-up is 16 months. 17 patients were retrospectively studied in 3 different hospitals using the same protocol and the mean follow-up is 26 months. Global results show a solid fusion in 26 (96 per cent) of the 27 patients at an average time of 15 weeks (range 12 to 22 weeks) after the operation. There was one mechanical failure of the implant (technical mistake during assembly of the compression screw component). There were 2 non-displaced fractures in the end of the nail. There was 1 displaced fracture and removal of implant was required, osteosynthesis was performed with a long intramedullary nail. No infections were detected. These results and others are related. Although good results observed, with high fusion rates and minimal complications, a potential disadvantage is the difficulty to remove the nail if this is necessary.

L38

BONE MINERAL DENSITY IN PROXIMAL TIBIAL EPIPHYSIS IN KNEE OSTEOARTHRITIS WITH VARUS DEFORMITY

Czerwiński E.¹, Kukiela R.T.¹, Nowak K.¹, Szyguła Z.²

¹Department of Orthopaedics Jagiellonian University Medical College, ul. Kopernika 19, Krakow. ² Department of Sports Medicine, Academy of Physical Education in Krakow, Al. Jana Pawła II 78, Krakow

Varus deformity is found in 90% of patients with knee OA. Axis deviation of lower extremity influences joint biomechanics and produce alteration in bone mineral density. Structure and density of subchondral bone of the knee was previously examined by X-ray. Densitometry gives us a new method of bone mineral content measurement in the interesting regions of the skeleton.

The aim of this study was the assessment of effect of varus deformity on bone mineral density in tibial epiphysis.

Bone mineral densities (BMD) were estimated in 46 patients at a mean age of 62 years (15 to 78) who were operated on in Department of Orthopaedics. All of them represented osteoarthritis of the knee with varus deviation. BMD of the proximal tibia was evaluated on the Lunar DPX-IQ densitometer and analysed in three regions of interest: medial, lateral and central. Lower extremity axis deviation was measured using the Metrecom devise (Faro). Results were compared to a control group of 20 patients without osteoarthritis of the knee and without deviation of lower extremity axis.

Increased BMD was found on the overweighed compartment of the knee in comparison to the underweight one. These differences were not observed in the control group. We developed a coefficient, which is the ratio of BMD in the overweighed compartment compared to BMD in underweight one. In our patients the mean value of this coefficient was 3.3, and it ranged from 1,2 to 24,5 (SD 5,7).

Significant correlation between varus axis deviation of the lower extremity and increased BMD coefficient was found.

L39

THE MANAGEMENT OF FRACTURES / DISLOCATIONS OF THE ELBOW WITH EXTERNAL FIXATION

Stavlas P¹., Gliatis J.², Koukos K.¹, Chatziargyropoulos T.¹, Dangas S.¹, Polyzois D.¹

¹Orthopaedic dpt. of “Thriasio” General Hospital, Athens, Greece

²Orthopaedic dpt. of University of Patras, Patras, Greece

Introduction. We present the results of the management of irreducible dislocation or fracture / dislocation of the elbow using the “Orthofix” external fixator in cases where the condition of the soft tissues was contraindicated for extensile surgical approaches or the internal fixation would not be stable enough to permit safe joint mobilization postoperatively.

Materials and methods. Twelve (12) patients were treated using elbow external fixation, 5 with supracondylar fracture and severe osteoporosis and 7 with fracture / dislocation of the elbow and excessive soft tissue impairment (two of them with open fracture). For the patients with fracture, we performed minimal internal fixation using small incisions and minor soft tissue detachments and then we applied the elbow external fixator for the neutralization of the fixation. This permitted the immediate active assisted joint mobilization postoperatively without interfering with the stability of the joint and of the fixation. The same happened for the patients that their elbow remained unstable after reduction of traumatic dislocation, where the external fixation maintained the reduction of the joint. Prerequisite for the safe mobilization of the joint was the application of the external fixation at the centre of rotation of the elbow which is the transepicondylar axis, in order to comply with the biomechanics of the joint.

Results. The fixator was applied for a mean of 10 weeks (6 – 16 weeks). All the fractures united and no instability of the joint was noted. The range of motion was between useful limits with lack of extension less than 30 degrees and flexion more than 130 degrees, pronation 60 degrees and supination 55 degrees (mean values). Pin track infection was presented in 3 patients and the treatment was local care and antibiotics. One patient had radial nerve palsy immediately after the operation, which recovered totally after four months without any treatment.

Conclusions. The external fixation of the elbow provides sufficient stability permitting the immediate mobilization of the joint postoperatively and in combination with the minimal soft tissue damage during the operation prevents the postoperative stiffness. It is a safe alternative solution when the condition of soft tissues around the elbow does not permit a thorough open procedure.

L40

SUPRACONDYLAR FRACTURE OF HUMERUS IN ADULTS : A NEW TECHNIQUE OF INTRAMEDULLARY TRANSOLECRANON FOSSA NAILING

Paramasivan O.N.¹, Younge D.², Moreau P.², Raja S.³

¹ United Lincolnshire Hospitals NHS trust, Lincoln, United Kingdom. ² King Faisal Specialist Hospital and Research Centre, Riyadh ,Saudi Arabia. ³ Blackburn Royal Infirmary, Blackburn,United Kingdom.

Displaced supracondylar fracture in adults often require internal fixation. Plate fixation, requires soft tissue stripping resulting in devitalisation of bony fragments and this predisposes to risk of non union, infection and nerve injuries. This is the first report of a new technique, locked intramedullary transolecranon fossa nailing.

In this technique the fracture is exposed through a limited posterior triceps splitting incision, keeping the soft tissue stripping to the minimum. The medullary canal is entered proximally through an anterior shoulder incision. A guide wire is inserted in an antegrade manner to enter the fracture site. The distal fragment is predrilled to create a tract with 3.2mm drill from proximal to distal, in such a way that the drill enters the olecranon fossa and then the proximal part of trochlea avoiding penetration of the elbow joint. The guide wire is then advanced into the tract in the distal segment. The medullary canal is reamed over the guide wire in antigrade fashion with flexireamer. Utilising the standard antegrade technique, the nail is inserted and advanced under direct vision until tip of the nail is firmly seated in the trochlea. The proximal and distal locking is done in standard fashion. Postoperatively active mobilisation is encouraged. Four patients underwent this procedure. All the fractures healed in 3 months and at one year follow up the average arc of elbow motion is 120 degrees. There are no complications.

Transolecranon fossa locked nailing is an available option to treat the displaced supracondylar fracture of humerus in adults.

L41

INTERLOCKING INTRAMEDULLARY NAILING OF HUMERAL SHAFT FRACTURES

Giannikas D., Pappas M., Karagiorgos A., Dimakopoulos P.
University of Patras Orthopedic Clinic, Rio, Greece

Aim of the study: End result study of closed intramedullary nailing of humerus fractures.

Method-material: Between 1995-2003, 42 patients with fracture of the humeral shaft were selected to be treated by I.N. The average age was 48 years old (17 years-82 years). The selection criteria were: a) loss of closed reduction (24 patients), b) pathological fractures (5 patients), c) non-union following external fixation (2 patients) and d) delay of union (7 patients). The intramedullary nail was inserted through a proximal entry point via transdeltoid incision. In 25 cases the entry point was below the greater tuberosity to avoid rotator cuff injury and in 18 cases the entry point was intraarticular. All nails were locked either proximal (41) or distally (1). Open technique was required for 21 cases. Passive full range of motion of elbow and shoulder joint was encouraged after the second postoperative day. Active assist exercises were indicated the second postoperative week. Bone healing was confirmed by clinical and radiological findings. Shoulder mobility was evaluated by the Constant-Murey scoring system.

Results: The average follow-up time was 21 months (9 months – 8 years). All fractures were finally healed. The average healing time was 13 weeks (8 weeks-13 weeks). Patients with extraarticular entry point of the nail had full passive shoulder motion between the 2nd and the 4th postoperative week, whereas patients with intraarticular nail application presented delayed passive shoulder motion with final limitation of the normal range of motion. Seven patients had painful shoulder motion 3 months postoperatively. There were 4 patients with neurapraxia of the radial nerve installed posttraumatic, who had full recovery 3 months later. There was one proximal migrated nail, which required revision. None of the patients required nail removal.

Conclusions: Intramedullary nailing of humeral shaft fractures seems to be reliable method of treatment. Shoulder mobilization after anterograde insertation of the nail can be easily restored with proper choice of entry point and proper physiotherapy program. The advantages of this method include: shorter operative time, less blood loss, small incision with minimal soft tissue damage. Extraarticular nail insertion should be the entry point of choice as there is no trauma to the rotator cuff.

L42

OPERATIVE TREATMENT OF DISTAL RADIUS NONUNION, MALUNION AND PSEUDOARTHRITIS

Kuropatkin G.V., Semyonkin O.M., Kulikov D.V.

Orthopaedic Surgery Department of Samara Regional Hospital, Russia

Introduction Distal radius fractures are the most common in the upper extremities and usually comminuted and unstable. The following techniques are usually used in treating these fractures: osteosynthesis with plates and screws (ORIF), Ilizarov device and the AO- external fixator, K – wires.

The main aim of the report is to study the results of surgical treatment of distal radius nonunion, malunion, and pseudarthrosis in cases when different techniques of fixation were used.

Material and methods. In 1998-2001 a clinical study of 48 patients (33 males and 15 females) with distal radius injury was conducted in orthopaedics department. The mean age of the patients was 42 years (15-69). 28 patients had the injury of their right hand and 20 - of their left hand. 19 patients had distal radius nonunion, 15 – malunion, and 14 – pseudarthrosis. The average time from injury to the surgical treatment was 5 months. The mean follow-up was 27,2 Months (12-36). The AO techniques (ORIF with titanium and stainless steel implants) were used in Group I (36 patients). Conventional techniques and fixators were used in 13 patients of Group II: home produced plates and screws, Ilizarov device, external fixator, K- wires. The indications for surgical treatment nonunion were: A3 type, B1 – B3 type, C1 – C3 type, accompanied by more than two criteria of instability. In 10 patients with extraarticular fractures we used osteosynthesis with dorsal or palmar T-plates (3.5 mm). Mini-«T» - and «Pi»-Plates (2,7 mm) were used in four patients who had comminuted fractures with tiny distal fragments ('bursting' mechanism). The Ilizarov device and K-wires were used in five patients. Radius reduction without rotational and angular deformity was considered to be an indication for shortening osteotomy of the ulna. Internal fixation with a 3.5 mm LC-DCP plate was used in six patients of Group I, and K-wires were used in two patients of Group II. The deformity of the radius required corrective osteotomy with a 3.5 mm T-plate fixation in five patients of Group I, in two patients of Group II we used home produced plates, screws, and bone autoplasty with a spongy graft from the iliac crest (14); in one patient a «Bio-oss» graft was used. In 7 patients we used Ilizarov device and K-wires.

Results. Pain relief was achieved in 87% of the reexamined patients from the Group I and in 72% - from the Group II. Bone fragments united in 31 patients of Group I (86%) and in 9 patients (75%). In one case a plate broke resulting in the relapse of pseudarthrosis. Application of the AO fixators allowed early mobilization, which helped to avoid post immobility contractures. Grasping power restoration in Group I was 76% (grip strength) and 82% (pinch strength) of the uninjured side. In Group II

grip strength was 55% and pinch strength - 69% of the uninjured side. In Group II there was consolidation in two cases of nonunion, Sudeck's syndrome developed in two patients. Contractures and progressive arthrosis in the wrist were also observed. Recovery of Group I patients was 2.5 times quicker than in Group II and the functional results were much better in Group I throughout the whole course of treatment.

Conclusion. In comparison with conventional fixators, AO-plates (ORIF) help to perform anatomically accurate and stable osteosynthesis, which, in its turn, helps to promote early mobilization, to reduce the complications. All this leads to a fall in the disability rate and invalidity of patients.

L43

TREATMENT OF SUPRACONDYLAR FRACTURES OF THE FEMUR WITH ENDOMEDULLAR RETROGRADE INTERLOCKING NAIL

Palencia Ercilla, J., Ruiz Valdivieso, T., Ardura Aragón, F.
Hospital Clínico Universitario de Valladolid, Ramón y Cajal, 3. Valladolid, Spain.

INTRODUCTION AND OBJECTIVES

Classical treatment for supracondylar fractures of the femur has been osteosynthesis with plate and screws. This treatment is not free of complications as non-union, infection and material breakage. An alternative to this treatment is endomedullary osteosynthesis with retrograde interlocking nail.

MATERIALS AND METHODS

We have reviewed 7 supracondylar fractures of the femur in 6 patients, treated with SCN retrograde interlocking nail. The average age of patients was 73 years. Traffic accidents were responsible of 3 of the cases, and the other 4 were due to low energy traumas. None of the fracture was opened.

The average follow up was 20 months (17-27), and clinical results were evaluated according to the Hospital for Special Surgery (HSS) knee evaluation scale modified by Leung et al.

OPERATION TECHNIQUE

Patients were placed in the supine position, without any longitudinal traction. We performed an anterior access with parapatellar arthrotomy. All nails were locked both proximally and distally. Functional recovering of the limb in discharge began during postoperative period for an average of 12 weeks (6-20).

DISCUSSION AND CONCLUSIONS

The results were fully satisfactory. The use of intramedullary locking nail in these fractures provides several advantages over standard treatment with opened reduction and internal fixation with plates and screws. Endomedullar nails have become the elective choice in shaft fractures of the femur, and with the use of interlocking nails, their indications have expanded to distal fractures of the femur. However, their use in supra and intercondylar fractures is not very expanded yet.

L44

EXPERIENCES WITH OSTEODENSITOMETRY AFTER DISTAL RADIUS FRACTURES CAUSED BY MINOR TRAUMA

Holnapy G., Nyíri P., Somogyi P.

Semmelweis University Budapest, Orthopaedic Department, Budapest, Hungary

INTRODUCTION: To determine the bone mineral density (BMD), the osteoporosis risk factors and the wrist function after distal radius fractures treated by non-operative methods at the Orthopaedic Department of Semmelweis University Budapest.

MATERIALS AND METHODS: 55 patients, between January 1999 and December 2000 (47 to 90, mean age: 69.4 years) were treated non-operatively after distal radius fracture following minor trauma. The osteoporosis risk factors were detected by an interview format and the BMD was measured in the proximal femur, in level LII-LIV vertebrae and in the contralateral radius. An adapted interview format was filled in six months following fracture healing to detect the wrist function.

RESULTS: Of the wrist-fractured patients 78% are osteoporotic, 20% are osteopenic in one of the examined region. 72.5% are osteoporotic and 17.5% are osteopenic at the contralateral radius. The T score is below -1 in LII-LIV. and the hip region in 80.36% and 67.92% respectively. Some of the patients had earlier fractures. Those, who had previous fracture before the age of 70, are all osteoporotic, and those who had no fracture previously are 64.5% osteoporotic, 22.5% osteopenic at the contralateral radius. At the LII-LIV vertebrae, those who had previous fracture, 60% are osteoporotic and 33.3% osteopenic and those who had no fracture previously are 27.7% osteoporotic, 44.4% osteopenic. At the proximal femur region, those who had previous fracture, 23% are osteoporotic and 53.8% osteopenic and those who had no fracture previously are 16.2% osteoporotic, 48.6% osteopenic. Patients with body mass index (BMI) under 25 are more osteoporotic in all of the measured region, than those with BMI over 25. We did not find significant difference in wrist function

of those who had a redislocation of 5° to 20° after the reposition and those who had fracture healing in an anatomical reposition.

CONCLUSIONS: The examined patients with a distal radius fracture are a high-risk population because of their high percentage of lower BMD. A wrist fracture resulted by minor trauma must be a warning sign: there is a higher probability of a following fracture due to osteoporosis. This might have a negative effect on life quality too. Therefore after a distal radius fracture there is a major importance of detecting the risk factors for osteoporosis, measuring the BMD in high-risk cases and starting the antiporotic therapy at the same time, to decrease the proximal femur and vertebral fractures rate.

L45

P.F.C. EXPERIENCES – TECHNIQUE- RESULTS- FUTURE

Westphal K.Ch.

Orthopädie, Klinikum Neustadt, Am Kiebitzberg 10, 23730 Neustadt, Germany

The „Press Fit Condylar“ (P.F.C ., DePuy Johnson&Johnson) knee implant was invented in 1984 as a cruciate-retaining endoprosthesis. 4 years later the cruciate substitution was added. In 1991 this as „P.F.C. modular“ well known system was upgraded for extended revision surgery with stems and augmentations called „Total Condylar 3“(T.C.3). Last evolution was in 1997 the P.F.C. Sigma with improvement of contact areas in patellofemoral and tibiofemoral joint and improved PE. Instrumentation was also modified. Femoral implant is made from CoCr-alloy, tibial implant from TiAlV, PE inlays and onlay patellae complete the implant. Cemented or cementless versions are available.

Good result in condylar knee implantation depend strictly on using the techniques of planning/ templating, correct aligned bone cuts and especially on adequate soft-tissue-balancing. Different situations of ligament and/or capsule laxity or contracture associated with various deformities need stepwise release-procedures. The modularity helps also to manage the great variety of arthritic knees.

The P.F.C. is one of the worldwide most used implants, a lot of studies showed good results. Using revision due to loosening as an endpoint a 10years survival rate from 97% or 15 until 21 years rate from 95-91% was published.

In future new technologies like navigation or robotics may help optimizing implants position and fit but a experienced surgeon will be absolutely necessary managing the operation and esp. the soft-tissue-part. Evolution of implantdesign and materials may in long term show new possibilities.