Impact Factor:

ISRA (India)	= 4.971	SIS (USA)	= 0.912	ICV (Poland)	= 6.630
ISI (Dubai, UAE)	= 0.829	РИНЦ (Russia)	= 0.126	PIF (India)	= 1.940
GIF (Australia)	= 0.564	ESJI (KZ)	= 8.997	IBI (India)	= 4.260
JIF	= 1.500	SJIF (Morocco)	= 5.667	OAJI (USA)	= 0.350

SOI: 1.1/TAS DOI: 10.15863/TAS
International Scientific Journal
Theoretical & Applied Science
p-ISSN: 2308-4944 (print) e-ISSN: 2409-0085 (online)
Year: 2020 Issue: 11 Volume: 91
Published: 16.11.2020 http://T-Science.org

QR – Issue QR – Article

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DYSPLASTIC COXARTHROSIS SURGICAL TREATMENT OPTION CHOICE DIFFERENTIAL TACTICS LITERATURE REVIEW

***Abstract**: In this article it was investigated about dysplastic coxarthrosis, comparison of domestic and foreign literature, complication and treatment, Arthroplasty of the hip joint, Primary endoprosthetics in dysplastic coxarthrosis.*
***Key words**: dysplastic coxarthrosis, treatment option.*
***Language**: English*
***Citation**: Irismetov, M. E., Azizov, A. M., Stupina, N. V., & Khakimov, A. D. (2020). Dysplastic coxarthrosis surgical treatment option choice differential tactics literature review. *ISJ Theoretical & Applied Science, 11 (91),* 174-182.
***Soi**: http://s-o-i.org/1.1/TAS-11-91-31 ***Doi**: crossref https://dx.doi.org/10.15863/TAS.2020.11.91.31
***Scopus ASCC**: 2700.*

Introduction

Main part.

Displastic coxarthrosis, as a consequence of congenital dislocation or hip subluxation, occupies one of the leading positions and represents about 77% [3] of the general pathology of the femoral joint. The normal development of the femoral joint requires an accurate, genetically deterministic balance between the development of the acetabulum and cartilage, provided that the femoral head is correctly centered. This balance can be disturbed during intrauterine development, which leads to the appearance of discongruence of the joint. Mechanical failure in the femoral joint is caused by excessive overloading of certain parts of the joint surface of the femoral joint due to anatomic deformation [11, 58, 59]. The development of osteoarthritis on the background of the femoral joint dysplasia is bound to happen, so the problem has a high social importance and requires careful study [2, 6].

An advanced comprehension of the clinical and radiological anatomy of the dysplastically changed femoral joint, taking into account the changes caused by the primary disease as well as the surgical interventions preceding the endoprosthetics, is especially important for further planning of the operation and the choice of endoprosthetic tactics.

The main changes in hip dysplasia depending on the severity of the lesion are: acetabular dysplasia - underdevelopment (beveled) of the roof, absence of walls [32, 33]; femur dysplasia - change of the neck - diaphyseal angle [28, 62], bend of the bone marrow canal, narrowing of the proximal femur, change of the neck torsion angle [15, 17, 21, 22, 37, 48, 54]. There are also some anatomical disturbances in the soft tissue surrounding the joint, for example, there is a shortening of the muscles, especially the adductor, quadruple and posterior hip muscles. The joint capsule is thickened and may be hourglass-shaped, making it difficult to open and mobilize the hip.

General terminology was worked out to describe the dysplastic hip joint, both normal and impaired hip biomechanics. Moseley [52] improved the differentiation of the language commonly used in hip pathology;

Concentricity is a measure of the circumference, or sphericity, which characterizes the ability of the joint to smoothly (unobstructed) perform a full range of movements.

Rotation center - in a spherical hip joint with a full volume of motion, the rotation center is very close to the center of the femoral head, in case of hip joint deformities, the true rotation center can be at a fairly large distance from the apparent center of the femoral head, thus increasing the effective lever of the abductor, at the patient develops an abductor roll and a positive symptom of Trendelenburg.

Coverage - the degree of coverage of the femur head, very often described as the central - edge angle, which is used in the diagnosis of children's age, in adults to measure the coverage of the femur head (inclamation) is used Sharpe angle.

Analysis of national and foreign literature has shown that with the rapid development of hip arthroplasty, not sufficient attention is paid to organ-preserving operations. Current works do not fully reflect the essence of the issue, and the results of observations are very diverse. At present, the arsenal of organ-preserving surgical interventions for the treatment of dysplastic coxarthrosis presents:

1.Corrective osteotomies:

1.1. proximal femoral bone,

1.2. pelvic bones,

1.3. combined - proximal femur and pelvic bones.

2.Plasticity of acetabulum roof.

3. Hip arthroplasty:

3.1. local tissues,

3.2. resection,

3.3. alloplasty.

4.Arthrodesis.

Corrective osteotomies

The human hip joint has very little tolerance for asymmetric loading, which leads to early development of coxarthrosis in non-congruent joints [11,30,58,78].

According to some authors, early surgical correction of acetabular dysplasia delays the onset of coxarthrosis [58,60]. Most researchers suppose that restoration of joint biomechanics by pelvic and/or femoral osteotomy at 5-6 years of age leads to excellent results, which cannot be said about the same operations in adults and adolescents. In any case, osteotomy in developed dysplastic coxarthrosis leads to pain reduction and restoration of satisfactory (acceptable) function for many years [12]. Reorientation of the body's tissues is more favorable than implantation of foreign materials at a young age. The main purpose of osteotomy in hip dysplasia is restoration of normal biomechanics through repositioning of joint surfaces. Close to normal biomechanics will improve joint function and durability. The degenerative process can be interrupted by increasing the area of the loaded joint surface, thereby reducing the load on the joint surface unit. Normalization of the hip joint biomechanics with improved hip head coverage will eliminate unnecessary loading on the joint surface unit and normalize the limb axis.

Osteotomies of the femoral joint can be divided into two main categories: reconstructive and palliative, depending on the disease severity.

Reconstructive osteotomies can be used in case of established deformation, before coxarthrosis. Palliative osteotomies are used at acute, but not at the last stage of the disease. Production of reconstructive osteotomies at expressed (severe) stage can accelerate the process of osteoarthritis development, and on the contrary, production of palliative interventions at early stages is unacceptable [50].

Of all types of pelvic osteotomies, we considered triple osteotomy. Triple osteotomy of pelvis is applied (including in combination with intervertebral osteotomy) in the early stages of coxarthrosis in adolescents after the closure of Y cartilage and in young age. According to A.M. Sokolovsky (1987), this operation is highly effective and can provide the centralization and complete coverage of the femoral head with acetabulum, restore or improve the congruence of the hip joint. The operation can be performed while maintaining the congruence of the femoral head and acetabulum and has a positive effect on the biomechanics of the femoral joint by improving the coverage of the femoral head and reducing the resulting forces acting on it.

Different types of pelvic osteotomies improve acetabular coverage and, according to many authors [35,51,77], facilitate the implantation of the acetabular component in further arthroplasty. Chiari, K. notes in his paper [16] that the preceding pelvic osteotomy facilitates further hip arthroplasty.

Intervertebral osteotomy changes biomechanical conditions of the hip joint functioning, which manifests itself in the change of load axis, redistribution of shoulder lengths of body weight and traction of surrounding joint muscles, reduction and more uniform distribution of intraarticular pressure per unit area of cartilage surface, muscle decompression, elimination of malposition of limb.

The main purpose of intervertebral hip osteotomy, in addition to relieving pain symptoms, is the redistribution of forces acting on a certain surface of joint cartilage.

Osteotomy of the proximal femur, which is a frequent indication for the removal of total hip replacement, should not complicate the course of subsequent endoprosthetics. Factors potentially complicating total endoprosthetics after osteotomy of the proximal femur section are: removal of the metal structure, deformation of the proximal femur section leading to inadequate installation and fixation of the prosthesis, or to intraoperative fracture of the femur and risk of infection.

Benke et al. note intraoperative complications in 7.6% of 105 operations of total endoprosthetics of femoral joint after the previously performed osteotomy of the proximal femur using a metal structure. [10]. To avoid this complication, it is desirable to remove the metal structure in 12-24 months after the osteotomy, which can also be used to achieve biological remodeling of the proximal femur, it is also possible to avoid complications such as fatigue fractures of screws, which complicate their removal, obliteration of screw holes, which facilitates the introduction of cement, as well as reducing soft tissue injuries and the risk of infection.

Soballe et al., [71], after 112 total endoprosthetics operations after medializing variational intervertebral femoral osteotomies, note that the occurrence of a fracture during the endoprosthetics correlated with the degree of medialization of the proximal femoral bone.

A.G. Charchyan and co-authors [4] describe casuistic cases, errors and complications in hip replacement, such as incorrect installation of components of the endoprosthesis (perforation of the cortical layer of the femur) after the preceding varifying - medializing intervertal femoral osteotomy, infectious complications, aseptic and septic loosening of prostheses, worn-out and migration.

Benke et al. also note the occurrence of a cortical layer fracture or perforation of the femur in 4.8% of cases at endoprosthesis after medializing intervertent femoral osteotomy [10].

According to Ferguson, G. M. [24], the preceding femoral osteotomy is associated with a large number of complications and revisions in arthroplasty.

In contrast to the above, Shinar A. A., and Harris, W. H. [69] note that the preceding intervertent femoral osteotomy did not affect further excellent results in endoprosthetics.

Boos N. Et al. [13] compared the results of 74 total endoprosthetics performed after previous proximal osteotomies of the femur with 74 operations performed in a control group over the same time interval. The authors found no major differences in the number of complications or number of revisions.

Intervertebral osteotomy of the femur is a technique of choice in young patients with initial symptoms of dysplastic coxarthrosis [21,76].

Plastic acetabulum roof

The idea of establishing a bone roof to provide support for the femoral head and prevent its subluxation in hip dysplasia was first proposed by F.Konig in 1891. Later on, the operation was significantly improved. The roof was formed by introducing a niche of bone auto- or allotransplants in the acetabulum roof.

Experience has shown that such operations were, in general, ineffective. Bone transplants due to the increased load on them were broken, resorbed, or moved in the cranial direction. In addition, used auto or homotransplants require a long period of restructuring and gradually decreasing in size from its original value, which reduces resistance to the load of the formed arch and changes its position.

Hip Arthroplasty

Arthroplasty as classic form with the use of pads made of allo- and auto cloth is currently almost not used, as in 27-35% of cases after 2-3 years, joint stiffness develops and pain increases. The term hip arthroplasty at the present stage involves interventions on the femoral and pelvic components with correction of the ratio of joint surfaces, destruction and osteoplastic replacement of cystic areas of subchondral bone in order to restore the structure and function of the joint.

Currently, the so-called true hip arthroplasty is developing, which includes both treatment of joint components and correction of biomechanical disorders.

Arthrodesis

In late stages of coxarthrosis, characterized by a severe deformation of the femoral head, along with endoprosthetics and arthroplasty, hip arthrodesis is used. In recent years, the indications for this operation have narrowed significantly.

Primary endoprosthetics in dysplastic coxarthrosis

Total hip replacement improves the function of the limb and relieves pain in patients with dysplastic coxarthrosis, but total hip replacement in dysplastic coxarthrosis is associated with significant difficulties due to the incomplete anatomy of the hip joint due to the primary disease and previous surgical interventions.

The reconstruction of the acetabulum is the most important part in hip dysplastic joint endoprosthetics. The best place to implant the acetabular component of an endoprosthesis is the true acetabulum [15,22,23,45,49,82], but it is also possible to implant in the place of neo-arthrosis [20,64,75], where there is enough bone tissue to implant a bowl of endoprosthesis without using a bone transplant and to avoid shortening of the femur. Studies by means of computed tomography on models using load [18,19] have shown that the load on the prosthesis increases significantly when the bowl is placed in place of neo-arthrosis, but even in this case, if adequate medialization is achieved, a significant reduction in load can be achieved [20]. Also, when the prosthesis is placed in place of neo-arthrosis, it is possible to impeach the bending and extension of the hip joint, which should also be taken into account. Russotti et Harris [64] noted in their study 16% of revisions in 37 cases when the bowl was placed in place of neo-arthrosis for 11 years. Pagnano et al. [57] noted that the bowls, located 15 mm above the true acetabulum, further led to more revisions of the acetabular and femoral components.

So, the main principle in the implantation of the endoprosthesis bowl is to obtain satisfactory coverage of the latter, which in most cases is achieved by deep rimming with a bowl of small diameter, if there is an adequate bone bed [80]. When using this technique, it is necessary to be careful not to damage the bottom of the acetabulum, which will reduce the amount of bone tissue and may lead to a fracture of the bottom of the latter during the operation or after the patient starts to load the limb while walking [17]. When using a bowl with a small external diameter, the femoral head should be 22 mm. in order to maintain an optimal thickness of polyethylene. Sochart et Porter studied the results of endoprosthetics of 60 hip joints with dysplasia or dislocation, operated according to this method using bone cement [72], 20 years after the operation 22 acetabular components were revised (37%). The probability of bowl operation was 97% to 10 years and 58% to 25 years. Besides, according to some data, cementless endoprosthetics of the bowl of small diameter gave equivalent results in elderly patients [40,66] and the best in young patients [65,67].

Also bone cement, auto - or acetabulum alloplasty [46, 47], and the use of strengthening rings can be used to provide adequate coverage [27].

To ensure reliable fixation of a bowl of endoprosthesis in acetabulum 70% of the latter should be covered with intact bone [53], the remaining 30% can be covered with auto - or allotransplant.

The head of the osteotomized femur bone can be used as an autograft, which, according to some authors, gives the best results [68]. According to some authors, early results after the use of a femoral head autotomial graft combined with a cement endoprosthetics technique led to satisfactory results in the overwhelming number of cases [26,31,34,40,79], although the remote results with this technique had a large percentage of loosening of the bowl, according to some authors [26,53], but according to others - the remote results with the use of autotomial grafts were also satisfactory [29,63].

Plasty of acetabulum with allograft leads to satisfactory results [31,41], although the number of complications in the distant period is greater in comparison with endoprosthetics without allograft [42,53,68].

A few words about strengthening rings in acetabulum reconstruction. Gill et al. [27] presented the results of 87 total endoprosthetics using strengthening rings developed by Muller concerning dysplasia of type II, III or IV according to Crowe et al. [17]. After an average of 9.4 years of observation, only 2 revisions were observed for aseptic loosening, one for dysplasia III and one for dysplasia IV degree. In both cases, the cement endoprosthetics technique was used. The authors advise to fill the acetabulum defects with autografts.

Ayvazyan A.V. offers metal reconstructive plates, developed by the author, which are strengthened by screws in the bone bed [1] for restoration of the flattened-ellipse shape of the acetabulum in dysplastic coxarthrosis. The author used bone cement to fill in the bone defect. From 2004 to 2008, 94 operations were performed according to this method.

The reconstruction of the femur also has its own difficulties in dysplastic coxarthrosis, for example, in dysplastic coxarthrosis there is a small diameter of the intramedullary canal, a dysplastic femur head, with a short neck, which is in the position of a sharp anteversion, and also there can be a sharp deformation due to previously transferred inter or posterior osteotomies [39]. In the presence of a sharp deformation, a second osteotomy may be necessary in order to safely position the femoral component of the endoprosthesis. The narrow canal facilitates the blockage of the femoral canal with cement, but there is a high risk of a cortical fracture and later a femoral fracture while the canal is being prepared for femoral implantation [17]. The problem of the very narrow femoral canal can be solved by splitting the proximal femoral bone at a distance of 8-10 cm at the front and back, after which the formed interval is filled with an autograft and fixed with screws [55].

In most cases, femoral anatomy requires the use of a small, short endoprosthesis component, since very often the femoral component is introduced directly into the thigh diaphysis rather than through metaphysis [8,38,41,55,80].

In hip arthroplasia endoprosthesis with dysplasia of I, II, III degree [17] it may be sufficient to use the usual femoral component. In case of IV degree dysplasia it is better to use narrow, lateralized femoral components, and in case of anteversion over 40 degrees to perform a detrotating osteotomy [7,36,54] or use modular implants with the possibility of anteversion correction [36].

Woolson et Harris examined 55 hip joints with cemented endoprosthesis, of which in 4 cases (7%) the femoral component loosened after 4.8 years on average [80].

Stringa et al. investigated the results of total endoprosthetics of 21 femoral joint using miniature femoral component in 15 cases [73]. All components were radiologically stable and asymptomatic for 10 years on average.

Silber et Engh in their work pay attention to the importance of using modular femoral components that help to change the anteversion, thereby reducing the possibility of dislocation [70].

Huo et al. used specially designed femoral components with an increase in offset of the femoral head by 30-40 mm with an alignment of the limb length [38]. A variated neck was developed to avoid impigmentation. Monitoring was carried out for an average of 57 months, during which there were no cases of revision.

Symeonides et al. studied the results of 74 total endoprosthetics in 64 patients with untreated hip congenital dislocation (74). All bowls were located at the level of the true acetabulum using cotiloplasty in 64 cases. Several methods were used to lower the femur to the level of the true acetabulum, including: reversible osteotomy, femur shortening (proximal resection), tendon tentotomy of the iliac-lumbar muscle, and in one case, distraction using an external fixation device. Plates and screws were used to fix osteotomies. During an average period of 7.2 years in 74 cases a sharp reduction of pain and improvement of function were obtained. One case of infection and three cases of loosening were observed.

If a bowl is placed in a true acetabulum at high dislocations, it is necessary in some cases to shorten the femur in order to avoid damage of sciatic nerve. Usually, when the bowl is placed in the true acetabulum, when the hip is lowered, the limb is elongated; when the hip is lowered by more than 4 cm, the risk of damage of the sciatic nerve increases [14,25,44].

Several methods have been suggested for the intraoperative hip replacement [80].

Hip shortening can be performed at the correct and subjective levels. This operation provides for hip reduction and correction of the anteversion of the femoral component. Reikeraas et al. have studied the results of substitutional shortening osteotomies in 25 cases of high dislocations (61). In all cases, a transverse abdominal osteotomy with rotational and angular correction was performed, distal fixation was achieved by endoprosthesis leg using press fit method. The average difference in limb length was 5 cm and the average elongation was 3 cm. There was one case of sciatic nerve paresis, one case of non-conversion and one case of incorrect fusion. During the next 3 years, not one of the joints was not revised.

Yasgur et al. also describe the results of subtrochanteric shortening osteototomy in the treatment of high dislocations (81). In all cases, transverse abdominal osteotomy was performed with rotational and angular correction according to indications, distal fixation was achieved with the help of endoprosthesis leg by press fit method with allograft strengthening by circlage.

Also osteotomies such as staircase osteotomies [55,56], double chevron osteotomies [9] and oblique osteotomies [8] were suggested for hip replacement.

Subtrochanteric osteotomies are very popular because they preserve the normal anatomy of the femur as far as possible, fixate the metaphyseal compartment, and avoid the problem of the metaphyseal and diaphyseal zone incompatibility in more proximal osteotomies.

Charchyan and co-authors suggest the use of distal shortening osteotomy, i.e., the shortening resection of the femur diaphyse at the border of the middle and distal third (about 2-3 cm), followed by osteosynthesis of the femur with a plate and screws [5]. According to the proposed technique, 14 patients were operated on; in all cases, according to the authors' data, excellent and good results were obtained.

Lai et al. considered the results of application of distraction devices for the purpose of hip lowering to total endoprosthetics [43]. 20 femoral joints with untreated dysplasia of type IV according to Crowe classification were operated with orthophemoral distraction apparatus for hip reduction to total endoprosthetics. In 12 cases it was also performed simultaneously with the application of the apparatus of tenotomy of the leading muscles of the hip. The distraction was performed within 8-17 days, with the average hip lowering by 4.5 cm. During the course of the distraction, there were no damages on the side of the vascular and nerve bundles and no infection. During 43 months on average 19 patients had excellent clinical results, 1 patient had good results. In 2 patients there was a residual sign of Trendelenburg, the difference in length of limbs was the greatest 2 cm.

So, in comparison with the reconstruction of the acetabulum, there are no big differences in the reconstruction of the femur bone. The main difficulties are encountered when deciding on the type of shortening osteotomy.

Conclusion

Recognizing the success of modern endoprosthetics, it can not be considered the it is only opportunity to treat patients with dysplastic coxarthrosis, especially young and middle age.

Thus, the analysis of publications on surgical treatment of degenerative-dystrophic diseases of the hip joint shows that a large number of surgical interventions are offered to treat various forms of coxarthrosis. However, to date, no clear indications for various types of surgery have been formulated, and the criteria for biomechanically justified correction of hip joint relationships in various forms of coxarthrosis have not been defined, taking into account not only X-ray data but also the activity of the pathological process. At present, the choice of surgery is based on the personal experience of the surgeon and is carried out by identifying the entire complex of biomechanical relationships in the joint, the stage of disease, the degree of dysfunction and individual features of degenerative-dystrophic process.

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