Osteoarthritis of the Fingers

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Arthroplasty • Arthrodesis • Osteoarthritis • PIP joint • DIP joint • Conservative treatment

Introduction

Osteoarthritis is the most common form of joint disease and constitutes a significant economic burden for western healthcare systems. Although treatment modalities have evolved, only a few studies offer evidence-based data on the effectiveness and long-term results of the different treatment options. Of all the different forms of osteoarthritis, the degenerative or idiopathic type is the most common and this has a high prevalence of finger joint involvement. Some studies suggest that the finger joints are the most common site of osteoarthritis in the entire musculoskeletal system [1].

The degree of functional impairment in OA of the fingers depends on which joints are affected, the degree of limitation of active motion, and the sector in which the deficit lies. If the MCP joints (which are rarely affected in patients with OA) are intact, an extension deficit of the PIP joint is functionally better tolerated than a lack of flexion.

Stability of the interphalangeal joints is an important issue, especially in the radial digits, since it is needed for a strong pinch with the thumb. Patients with an erosive and inflammatory type of OA in these joints may have significant instability and deformity, which must be addressed when evaluating surgical treatment options. The deformity may not only be a functional problem but also an aesthetic one, especially in the DIP joints, where marked osteophytes may be observed.

The increasing number of patients affected by this disease, together with the increasing therapeutic possibilities, make this probably the fastest growing patient population in hand surgery.

Background/Aetiology

Degeneration as a process of aging has long been the simple explanation of osteoarthritic diseases in different joints. Newer studies provide increasing evidence that an individual's genetic background has an important role in the development of OA, and new genes that are important in the pathophysiology of joint destruction have been detected [2]. Goekoop et al. [3] found that the absence of OA in 90-year-olds was associated with male sex, a normal BMI,

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absence of familial predisposition and (surprisingly) heavy physical work. These findings were irrespective of the site of the OA. Dietary influences on the development of OA are strongly disputed. Data from Williams et al. [4] suggest that a diet rich in fruit and vegetables has a beneficial effect on the development of OA.

It has been shown that the cumulative incidence of finger joint osteoarthritis is generally higher in women but the distribution over the different finger joints is the same in both sexes. The distal interphalangeal joint (DIP) is most frequently involved, followed by the thumb saddle joint (CMC I) and the proximal interphalangeal joint (PIP), while the metacarpophalangeal joint (MCP) is rarely affected. Handedness seems to play no part in the development of OA in the finger joints [1].

If the MCP joint shows clinical symptoms and corresponding changes, especially in the second and third fingers, this may signal underlying disease. Both hemochromatosis and chondrocalcinosis have to be actively ruled out [5]. Hemochromatosis typically shows similar degenerative changes to primary OA, with subchondral cyst formation, sclerosis, and thinning of the cartilage. On the other hand, chondrocalcinosis, involving both fibrous and hyaline cartilage, often affects the scaphotrapeziotrapezoid (STT) and the CMC I joints and shows calcifications in the triangular fibrocartilage complex (TFCC) [6].

Overall, the prevalence of OA in the fingers is two to four times higher in women than in men [7]. The duration of the woman's fertile period as well as the age at menopause showed a positive relationship to DIP joint OA, suggesting a strong hormonal dependence [8].

Pearls: Aetiology

Genetic predisposition seems to be a major factor in disease development.

The prevalence of OA in the fingers is two to four times higher in women than in men, and late menopause is a negative predictive factor.

The DIP joint is the most frequently affected joint in primary osteoarthritis of the hand, followed by the thumb saddle joint and the PIP joint. MCP joints are rarely affected by this disease.

Fig. 6.1 Typical pattern of a osteoarthritis of the small finger joints combined with a peritrapezoidal ostearthritis

Presentation, Investigation and Treatment Options

The presentation of OA in the fingers is quite uniform; the diagnosis is based mainly on the clinical picture and confirmed by conventional radiographic examination (Fig. 6.1). The American College of Rheumatology defined the following criteria for the classification of OA of the hand in comparison with rheumatoid arthritis and other inflammatory joint diseases: hard tissue enlargement involving at least two of the ten selected joints (second and third DIP and PIP joints, and CMC I on both hands); swelling of fewer than three MCP joints; and hard tissue enlargement of at least two DIP joints. This classification method has a sensitivity of 92 % and specificity of 98 % [9].

Patients classically present with swollen, tender DIP or PIP joints. Mucoid cysts, with or without nail deformity, are often seen at the level of the DIP joint. The PIP joint has a more diffuse, swollen appearance with a fusiform joint contour. Joint stiffness is almost always present and often correlates with the degree of swelling.

Most authors still use the Kellgren and Lawrence scale [10] for the radiographic classification:

Grade 1: doubtful narrowing of joint space and possible osteophytic lipping

Grade 2: definite osteophytes, definite narrowing of joint space

Grade 3: moderate multiple osteophytes, definite narrowing of joint space, some sclerosis and possible deformation of bone contour

Grade 4: large osteophytes, marked narrowing of joint space, severe sclerosis and definite deformation of bone contour

The initial phase of disease sees the onset of an inflammatory process that comes to a halt at a later stage [11]. This explains the fact that many patients have fewer symptoms in the end stage of the disease than at the beginning. The DIP joint, in particular, can become asymptomatic with time and not need any further treatment. The PIP joint often has residual limited but painful motion.

Ultrasound examination findings do not correlate with the clinical disease or the severity of damage seen on X-ray [12].

MRI studies of finger OA reveal that primary osteoarthritis shows more erosive joint changes than previously thought or indicated on conventional radiographs [13]. However, MRI does not belong in the routine investigation of OA of the fingers and no validated scoring system is yet available [14].

Scintigraphy is used as a screening tool only in unclear cases with polyarticular symptoms and no conventional radiographic changes in the joints.

CT scans are rarely, if ever, indicated in OA to examine symptomatic joints in the fingers.

Pearls: Investigations

The diagnosis of osteoarthritis in the fingers is based on the symptoms and the clinical picture, confirmed by conventional radiographs. Further investigations are rarely needed.

The initial phase of the disease often shows an inflammatory process, which diminishes with time.

DIP joints may become asymptomatic as the disease progresses, despite marked destruction and deformity.

Treatment Options: Conservative Treatment

Osteoarthritis is an incurable disease and all attempts to treat this condition do no more than modify the symptoms or repair the damage. There is little evidence that any sort of prevention might be effective in stopping unaffected joints becoming part of the disease process. In the pathophysiology of the disease, catabolic cytokines and anabolic growth factors play key roles in the destruction of the cartilage. TNF-alpha-blocking agents, used mainly in patients suffering from rheumatoid arthritis, are good candidates for suppressing the destructive inflammatory process in OA as well. Beside the classic systemic application of this drug, an intra-articular treatment with injection showed in a pilot study a good symptomatic effect with a possible disease modifying action of intra-articular Infliximab in erosive osteoarthritis of the hands [15].

Conventional treatment includes analgesics and non-steroidal anti-inflammatory drugs. Intra-articular viscosupplementation with hyaluronic acid has been shown to be effective in terms of pain relief and improved disability. In comparison with intra-articular corticosteroids, it seems to have a longer benefit [16], especially in the knee joint. However, personal experience does not support this observation for the finger joints.

Glucosamine and chondroitin are important components of the normal cartilage. Like viscosupplementation, the efficiency of glucosamine and chondroitin in the treatment of OA has been documented best in the knee joint [17]. They seem to reduce the need for anti-inflammatory drugs and improve functionality [18]. Since these substances are of natural origin (fish and other animal cartilage) few side effects have been reported. Most authors recommend a combination of the two, at a dosage of 1,500 mg glucosamine and 1,200 mg chondroitin daily. Since the onset of the effects is slow and takes at least 4 weeks, most authors recommend either 3 months' therapy twice a year or continuous treatment [18].

In the fingers, the PIP joint reacts well to intra-articular corticosteroid injections, while

injection of the DIP joint is often painful and has limited effect. The side effect that is most common and difficult to control is atrophy of the skin and subcutaneous tissue, which is more of an aesthetic than a functional problem. There seems to be no correlation between the radiographic appearance of the joint and the effectiveness of intra-articular steroid administration. The infiltration seems to lose its efficiency with time and, together with the side effects, this therapy is self-limiting. There are different techniques for PIP infiltration: we prefer to inject into the dorsal recess of the joint.

Splints for painful inflamed joints might be effective but their regular use limits the functionality of the hand and patient satisfaction is low [19]. Modification of activity may be beneficial in preventing articular inflammation. Joint protection devices may relieve the joints and help to prevent further irritation of the joints affected.

The effects of ultrasound, laser and electrotherapy in the treatment of OA in the fingers are not well documented. Experience has shown limited and short-term effects with an often inappropriate cost-efficiency ratio.

Pearls and Personal Recommendation: Conservative Treatment

OA of the fingers is an incurable disease and all attempts to treat the condition are limited to modifying the symptoms and, at best, to slowing down its progression

Anti-inflammatory therapy is the mainstay of conservative treatment in OA. Intra-articular corticosteroid infiltration is the most efficient, especially in the PIP joint. Possible side effects should be discussed with the patient.

Glucosamine and chondroitin may act as anti-inflammatory agents with a certain chondroprotective potential. Three months' trial therapy with 1,500 mg glucosamine and 1,200 mg chondroitin daily is recommended.

Treatment Options: Surgical Treatment

Surgical treatment options include synovectomy, joint replacement, and joint fusion. There is no literature on synovectomy of the PIP joint for patients suffering from OA. Synovectomy may be considered in the early stages of the osteoarthritic process when there is marked inflammation and the cartilage is still preserved. There is speculation that the physical removal of the synovial mass, together with a denervation effect, might relieve the symptoms. Since no data on the mid- and long-term effects of that procedure are available, we can only report our personal experience of this intervention. Overall, the results of this procedure are mixed at best. Persistent, if not even exacerbated, pain and postoperative joint stiffness are possible complications. We find that the best candidates for this procedure are patients who had a good response to intra-articular steroid injections and have more than 80 % cartilage preserved in the affected joints. But even in this selected patient group, there is only a 50-50 chance of a good result.

In the DIP joints, mucoid cysts are quite often the first sign of a degenerative process. The typical clinical presentation is a swelling distal to the DIP joint, which may involve the subcutaneous tissue and even the skin (Fig. 6.2). Nail deformities are often seen if the cyst presses on the germinal nail matrix. Treatment options include aspiration, injection with corticosteroid, and cyst excision with or without the skin involved. If joint destruction is already advanced, a definitive surgical solution such as joint fusion is indicated.

Aspiration alone has an extremely high recurrence rate of more than 90 % but its

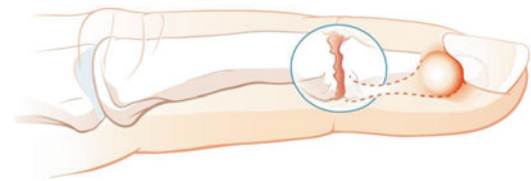

Fig. 6.2 Mucoidcyst of the DIP-joint with pressure on the germinative nail matrix and subsequent nail deformity

combination with an infiltration of locally acting corticosteroid lowers the recurrence rate to 40–50 % [20]. Surgical removal of the cyst carries by far the lowest risk of recurrence – reducing it to less than 5 %. Whether the overlying skin has to be removed and a rotational flap applied is a matter of debate. If the skin is extremely thin or spontaneous drainage has been observed, excision of the involved skin makes sense. Very occasionally, the skin defect is of a size to require soft tissue coverage other than a local rotational flap. The preoperative nail deformity, mainly nail ridging, often resolves within one or two generations of nail after the cyst has been removed.

If finger joint destruction is advanced, a definitive treatment solution has to be found. Joint replacement is the only functionally acceptable option for the MCP joint, although this is rarely affected by primary OA. The rules for joint replacement discussed in the chapter on rheumatoid arthritis should be followed.

The ideal goal for reconstruction of a disabled PIP joint is a pain-free restoration with functional mobility and adequate stability. The index and middle fingers are the pinching partners of the thumb, while the ulnar fingers need mobility in order to grasp larger objects. When considering joint replacement, the degree of instability and deformity has to be taken in account. Experience shows that pre-existing deformity and instability in the PIP joint is difficult to correct, even with formal collateral ligament reconstruction and prolonged splinting during rehabilitation (Fig. 6.3). Arthrodesis should therefore be considered carefully, especially in the radial digits, if the lateral deformation of the PIP joint exceeds 30°. PIP joint fusion in a functionally good position provides adequate function, although fine motor skills in particular are affected. Woodworth et al. [21] evaluated the impact of simulated PIP joint fusion on all four fingers with the PIP joint fixed in 40° of flexion. Low-demand activities of daily living suffered significantly when compared with unrestricted motion in all finger joints, while precision handling was perceived to be more difficult and required more compensation by the MP joints.

Simultaneous fusions of the PIP and DIP joints in the same finger ray are possible, although precision handling will suffer. The combination of PIP arthroplasty and DIP fusion is functionally much better tolerated even if the range of motion in the PIP joint is limited.

PIP joint replacement is a widely accepted procedure in joints with OA destruction. The choice of implant and the approach used are the two most frequently discussed issues. A variety of implants is available, but only a few series with adequate long-term follow-up have been published. Silicone implants, introduced by Swanson in the late 1960s, are still the gold standard for newer generations of implants with respect to functional performance, revision rate, and long-term outcome. Silicone joint spacers carry a risk of implant breakage and silicone synovitis. Newer implant designs of the resurfacing type may, however, show dislocation and implant loosening. Overall, the silicone spacer produces fairly consistent results with good pain relief and reasonable function, with a range of motion between 40° and 60° active flexion/extension. Only a few cases with relevant silicone synovitis have been reported and, although implant failure is seen, it does not necessarily lead to revision [22–25]. There is a newer generation of silicone implants such as the NewFlex™ and the Sutter prosthesis. These devices have a more rectangular shape, which should provide better stability of the joint. Since the anatomical shape of the subcapital bone of the proximal phalanx is more elliptic, the rectangular shape of these hinges may interfere to some extent with the extensor mechanism, so it is essential that the implant is placed correctly. No randomised controlled trials with series of different silicone implants in the PIP joint are available, and analysis of the different case series suggests similar results for most of the Silicone implant designs.

The newest generation of PIP joint prostheses follows the principles of surface replacement with a two-component concept. The proximal component replaces the bicondylar head of the proximal phalanx and the distal component has some sort of a cup, which articulates with

Fig. 6.3 Recurrence of a pre-existing deformity of a PIP joint suffering form OA and subsequent treatment with a silicone PIP arthroplasty. (**a**) Preoperative status with the ulnar deviation (**b**) Postoperative appearance after 6 weeks with good alignment (**c**) Recurrence of the deformity at the PIP joint 12 months after the intervention

the head. Taking a closer look at the implants, they do not represent a real resurfacing concept, since a significant amount of bone has to be resected and long stems for both components are needed to provide adequate fixation. Several material combinations are available, from the classic chrome cobalt/polyethylene to ceramic/ceramic and pyrocarbon/pyrocarbon. Most of these implants can be used without cement, although some of them require cementing for primary fixation in the bone. The majority of surgeons prefer non-cemented implants, since revision is easier and removal of the implant causes less damage and bone loss. Overall, the newer generation of PIP implants based on the resurfacing concept seemed a logical development in PIP arthroplasty, but most of them have not yet stood the test of time and real-life long-term follow-up series are still lacking for most implant designs.

The concept of resection-interposition arthroplasty, with a volar plate for example, is reported only for traumatic or post-traumatic conditions. No formal series has been published for joints with osteoarthritic destruction.

For the vast majority of hand surgeons, arthrodesis is still the standard procedure for treating a deformed and painful DIP joint. It gives consistent, sustained results and allows the correction of pre-existing deformity. This treatment concept is the result of the observation that DIP joint fusion can occur spontaneously in patients suffering from OA and is functionally well tolerated. Most patients experience slow degradation of DIP joint motion in the course of the disease and adapt to that functional impairment quite well. Although DIP joint movements become more important when there is also limited PIP joint mobility, fine motor skills in particular suffer from additional DIP joint restriction. The option of DIP arthroplasty has been advocated for these cases. Although it is logical as an alternative to joint fusion, DIP arthroplasty has so far made no real breakthrough in most surgeons' treatment concepts. The few publications suggest this procedure as a good alternative to DIP fusion [26, 27].

Pearls and Personal Recommendation: Surgical Treatment Options

Removal of mucoid cysts in the DIP joint is most successful when there is only mild destruction of the joint. Mucoid cysts in combination with advanced destruction of the joints are best treated with DIP fusion.

PIP synovectomy in OA of the fingers produces mixed results and the indication must be considered carefully.

The standard treatment for painful destruction of the PIP joints is arthroplasty, or arthrodesis in selected cases, and joint fusion in the DIP joint.

Surgical Techniques and Rehabilitation

PIP and DIP arthroplasty and arthrodesis are the most common surgical procedures in patients with joint destruction from primary OA in the fingers. The following section focuses on these treatment options.

PIP Joint

PIP arthroplasty has a shorter history of use than MCP joint replacement. For decades, joint fusion was the standard procedure for painful PIP joint destruction and the functional results of this procedure were generally reported to be good [28]. Pellegrini and Burton [29] reviewed a number of patients who had undergone different procedures for PIP joint destruction. They observed that arthrodesis in the radial digits brought an improvement in the lateral pinch, while arthroplasty in the ulnar digits gave reasonable functional mobility with good pain relief. Based on this analysis, the authors were not able to make a definitive recommendation on the optimal procedure for destroyed PIP joints. Since that publication, however, several authors have advocated the concept of reserving PIP arthroplasty for ulnar

digits and treating the index finger, which is the main partner for pinching with the thumb, with PIP joint fusion. We have adapted the concept in that PIP arthroplasty is indicated in all digits, but the rehabilitation programme in the index finger is modified. Functional exercises with the index finger are begun later and functional splinting is prolonged in order to protect the radial collateral ligament, which is most important for the lateral stability of this joint. The goal of index finger rehabilitation after PIP arthroplasty is not maximum mobility but an optimal balance between mobility and stability.

Contraindications to PIP joint replacement include the classic criteria of insufficient bone stock, missing or dysfunctional tendons, and severe tendon imbalance, especially contracted boutonnière and swan-neck deformities. In severely contracted joints with a long-standing history of immobility, PIP joint fusion in a functional position may be a better choice than implant arthroplasty. Severe joint instability and deformity of more than 30° is extremely difficult to correct with an implant and is a relative contraindication to arthroplasty.

The choice of implant depends on several factors, including the surgeon's experience, the local anatomical situation, especially the bone stock, and the surgical approach. Silicone devices, which act as joint spacers, are by far the most forgiving implants. They provide reproducible results even in cases with difficult bone stock and with limited surgical experience. They can be implanted easily using different surgical approaches. More complex, two-component joints need an adequate bone stock; no large cystic defects can be allowed to exist with implants, as they have to be inserted without cementing. Correct placement, with the goal of restoring the biomechanical centre of rotation, needs some experience. Some of these implants are supplied with resection guides, which can be used only with a dorsal approach. In addition, some prostheses need more space for implantation, which also means that a dorsal or lateral approach is required.

Different surgical approaches have been described to implant a PIP joint replacement. All of them have theoretical advantages and disadvantages. So far, no one approach has proved to be superior to the others, although the theoretical advantages of the volar approach are now being discussed. The **dorsal approach** is the most widely used and technically least demanding in comparison with the volar and lateral approaches. It is also required when certain soft tissue conditions, such as mild swan-neck or boutonnière deformity, are to be corrected at the same time. A straight or slightly curved longitudinal incision is performed. The dorsal veins should be preserved if possible and care taken with the dorsal nerve branch to the PIP joint. Several techniques have been described to access the joint. Swanson [25] advocated a midline split of the central slip of the extensor tendon. Care should be taken to preserve the insertion of the central slip at the base of the middle phalanx, since a good view of the joint is usually only possible if some of the insertion is released on the ulnar and radial sides. Transosseous reinsertion of the central slip may therefore be necessary after the implantation. A good alternative, and our choice, is the approach described by Chamay [30]. He uses a V-shaped extensor flap, which offers a good view of the joint and allows a long stable suture line for tendon closure. After exposing the joint, the most dorsal parts of the two collateral ligaments are released; this gives full access to the joint with a perfect overview. Dorsal and even volar osteophytes can now be removed. Care has to be taken not to violate the insertion of the central slip. The bone is prepared according to the needs of the selected implant. For silicone implants, the resection line is planed according to the implant size (most often size 1 in the original Swanson design) and care should be taken to preserve as much of the collateral ligaments as possible. After bone preparation, the trial implant is inserted and a trial reduction is performed. The tension should be chosen so that full flexion and, in particular, extension is possible. Either a smaller implant or more bone resection is needed if there is an extension lag. When there is significant joint deformity or deficient collateral ligaments, reinforcement suture of the ligaments and/or a staged release is needed on the contracted side. The sutures are passed within the ligament and reinserted through drill holes in the proximal phalanx. The joint should now be well balanced but with a full passive range of motion still being

possible. It is virtually impossible to correct any deformity remaining on the operating table, even with a well-applied rehabilitation programme.

After skin closure, a standard hand dressing is applied, including a volar splint.

Rehabilitation must be individualized according to the intra-operative stability, the collateral ligament status, and the finger ray. A more conservative rehabilitation programme is not started until 2–3 weeks after surgery for the index finger and for any joints that were severely deformed and consequently required collateral ligament re-balancing. Theoretically, the long suture line in the extensor tendon allows early active mobilization. Resting splints in the intrinsic plus position are worn for up to 6 weeks. Buddy splinting to the neighbouring radial finger, with a figure of eight dressing, is a good way of protecting the collateral ligaments and yet still allowing an active and passive range of motion. Individual adaptations need to be made during the rehabilitation programme. If the joints become stiff early, more vigorous mobilisation is needed. In general, dynamic splinting is rarely needed and not tolerated by the soft tissues until 4–6 weeks after surgery. In our experience, an extensor lag is the most commonly observed deficit following the dorsal approach. The reasons could be scarring of the extensor tendon with subsequent loss of free gliding or a certain excess length of the extensor mechanism. Night splints in extension and dynamic extensor splints may help. In cases of a mild, passively correctable swan-neck or boutonnière deformity in combination with destruction of the PIP joint, a dorsal approach is essential for joint replacement. Careful attention should be paid to the cause of the swan-neck deformity, as this is very often found at a different level from the PIP joint. These cases require release of the lateral bands, often in combination with lengthening of the central slip. A central slip reconstruction or reinforcement is needed with boutonnière deformity. Several techniques have been described for this difficult procedure. Overall, PIP arthroplasty has limited results in the presence of these deformities and there is an inherent danger that the joint will become stiff or that the deformity will recur.

The **volar approach** has, at least theoretically, several advantages over the other approaches. The tendons are not violated with this technique and, in particular, the delicate extensor mechanism remains untouched. The venous drainage is less compromised, which results in less postoperative swelling and easier subsequent rehabilitation. However, the volar approach is technically more demanding and offers less space for the implantation of an artificial joint. In addition, pre-existing tendon imbalances are more difficult to correct. The technique described by Simmen offers good access to the joint [22]. A Bruner incision forms a radially based skin flap. The two neurovascular bundles are identified and protected. The ulnar bundle has to be mobilised, while the radial bundle remains with the skin flap. The flexor tendon sheet is opened transversely in the area of the A3-pulley on both the volar and the dorsal side. On the ulnar and the radial sides, the incision is continued to form a sleeve, which includes the release of the accessory collateral ligaments (Fig. 6.4). Access to the joint is now achieved with hyperextension. Some release of the ulnar collateral ligament may be needed if the joint is not supple enough to get a good exposure. The osteophytes, especially those on the volar side, can now be removed. This is important since they may be a potential site of impingement with the implant in flexion. The head of the proximal phalanx can now be resected but care has to be taken to identify the ulnar neurovascular bundle and protect it with retractors. Preparation of the bone and implantation of the prosthesis follow the same principles as for the dorsal approach. For closure, the pulley sleeve is retracted and reattached in its anatomical position. In cases with pre-existing deviation of the flexor tendon due to lateral deformity, the tendon can be re-centred. If need be, the collateral ligaments can be reinforced with sutures. It is important to test the passive range of motion again before final closure. The rehabilitation programme follows the principles outlined for the dorsal approach but no special protection of the extensor tendons is needed, and even passive motion is allowed.

The **lateral approach** is the least common approach used for PIP implants. The incision goes along the midline on the ulnar side of the finger and curves dorsally on the middle phalanx. After releasing the oblique and transverse fibres

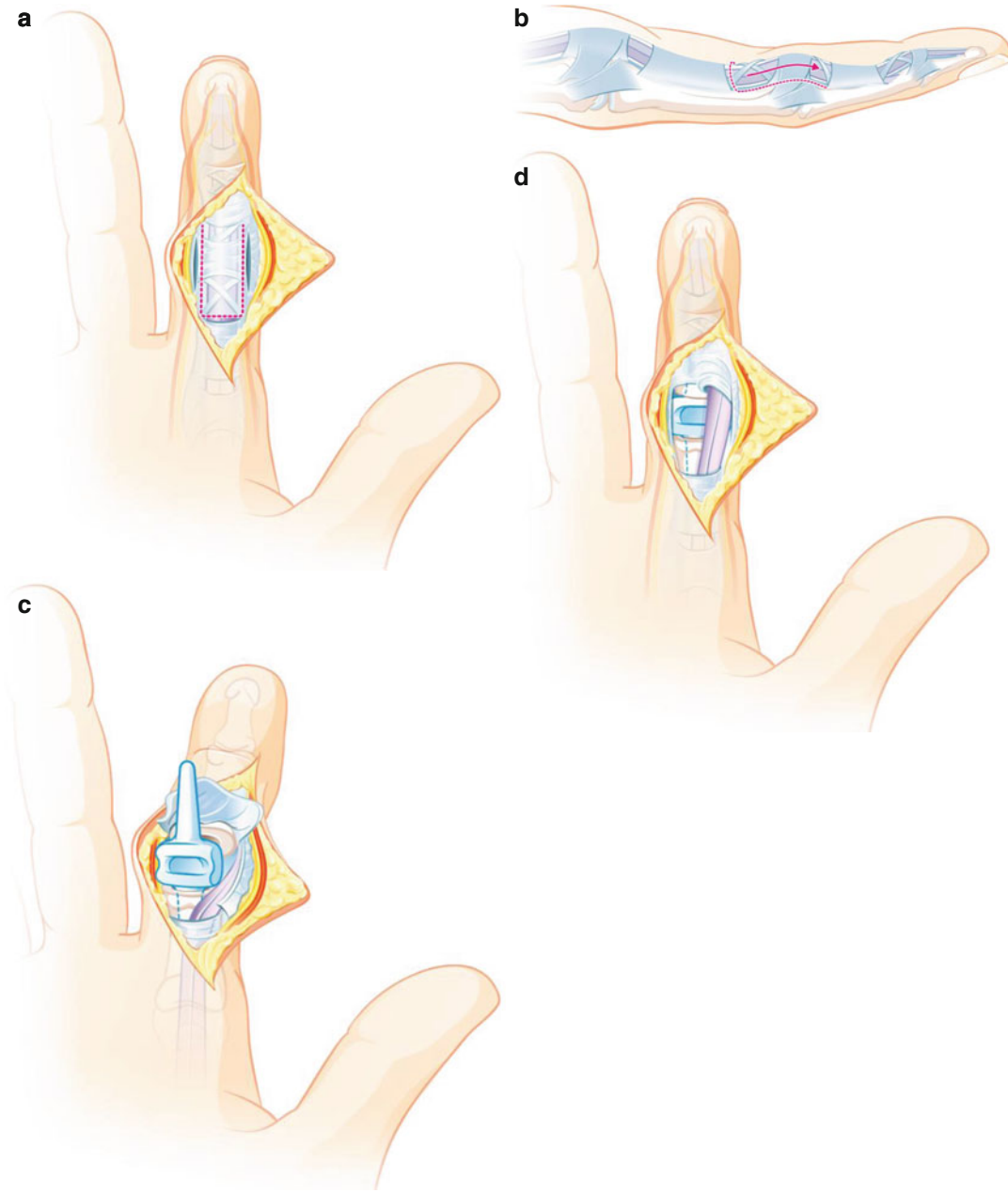

Fig. 6.4 Volar approach for PIP arthroplasty. (**a**, **b**) A sleeve of the flexor pulley system is formed starting at A3 pulley, including the release of the accessory collateral ligaments. (**c**) Reflexion of the flexor tendons and after the preparation of the bone the implant can be inserted (**d**) Final appearance after joint reposition. The flexor pulley sleeve can be re-fixed and immediate active and passive rehabilitation is possible

of the retinacular ligaments, the extensor apparatus is elevated and can be mobilized laterally, with the insertion of the central slip remaining intact. The ulnar neurovascular bundle remains on the volar side of the joint. The ulnar collateral ligament has to be detached completely in such a way that the joint can be opened on the radial side. This is best done with a triangular proximally based flap that can be reflected proximally. The implant can be inserted as described previously.

For closure, it is essential to reattach the ulnar collateral ligament in such a way that active rehabilitation is possible. The ulnar side has to be protected with buddy splinting for up to 6 weeks.

Arthrodesis of the joint may be indicated in cases of severe instability and deformity of the PIP joint or difficult bone situations. Several techniques have been described for this procedure. Tension band wiring, plate fixation, and screw arthrodesis are the most common techniques. Tension band wiring has the advantage that compression of the arthrodesis site occurs during active motion. This technique is also cost-effective, using inexpensive hardware. The disadvantages are possible pin protrusion and painful hardware requiring subsequent metal removal [28]. Plate fixation, usually 2.0–2.4 mm in size, allows rigid fixation at the desired angle. It has the disadvantage of causing extensor tendon adhesions along the plate, thus limiting DIP motion. The newer-generation plates are so thin that hardware removal is not necessary in most patients. The screw fixation technique, preferably with a headless screw, is another option. Theoretically, a single screw has no rotational stability but in practical use this does not cause any problems [31]. The main challenge with the screw technique is to achieve the desired fusion angle. This is not so easy to accomplish, especially for angles less than 30°. The straighter the fusion position, the more difficult it gets to obtain adequate purchase on the distal volar fragment. The screw also has more potential for protrusion on the proximal dorsal cortex.

The joint is approached from the dorsal aspect. The central slip of the extensor tendon is split and the joint opened. After removing the osteophytes and releasing both collateral ligaments, there is a good view of the joint. The osteotomy should be performed in such a way that the desired fusion angle is set on the proximal part and a perpendicular bone cut is made on the distal part. Suitable fusion positions are usually 15–20° of flexion angle in the radial digits and 25–40° in the ulnar joints. Trial reposition is performed and can be held in place with a temporary K-wire. Fluoroscopic control should confirm good bone contact over the whole area of the osteotomy. Once this preliminary fixation has been done, the hand is removed from the operating table to check the three-dimensional appearance of the finger. Rotational malpositioning, in particular, has to be avoided. Definitive fixation is then performed. The extensor tendon is sutured over the hardware to cover it, and the remaining DIP motion is checked.

Postoperatively, the PIP joint should be protected in a finger splint for 6 weeks. Early mobilisation of the DIP joint out of the protective splint is started after a few days. Bone healing should be confirmed with radiographs 6 weeks after surgery.

DIP Joint

The standard procedure for treating painful destroyed DIP joints is joint fusion. In OA, the DIP often presents with a marked deformity, significant osteophytes, and an active range of motion that is already limited. With DIP fusion, the joint can be brought into a functionally good position and a definitive solution can be offered with a single procedure. The cosmetic appearance is often much better once the deformity has been corrected, something that is important to the mainly female population with this disease. There are several techniques described for DIP arthrodesis. Screw fixation, K-wires, and tension band wiring are the most commonly used. Newer implants such as endomedullary staples, providing purely intramedullary fixation, are also available and have the advantages of not requiring any secondary hardware removal and not causing any irritation of the fingertip. The screw technique has the advantage of immediate strong fixation with a low complication rate [32]. K-wires may be needed in difficult bone situations where screw fixation is not possible or in cases with a significant mismatch between the size of the screw and the dimensions of the phalanx. Screw fixation with a 2.0 mm screw is possible in almost all cases of osteoarthritic destruction of the DIP joint, although sometimes a 1.5 mm screw is necessary for the small finger. Although several authors prefer a headless screw, it is our experience that a regular 2.0 mm AO screw can be placed in such a way that the head does not irritate

the fingertip. The length of the screw is somewhat critical, especially in patients suffering from concomitant destruction of the PIP joint, which might require subsequent joint arthroplasty. It is usually possible to get enough purchase with a screw length of about 30 mm, since the shape of the medullary canal of the middle phalanx is at its narrowest about 15–20 mm proximal to the joint line. In most cases, it is still possible to do a PIP arthroplasty with a screw of this length, either at the same time or later without removing the screw. K-wire fixation is often less convenient for the patient, since additional immobilization of adjacent joints is necessary due to the limited primary stability of the fixation. There is a higher risk of infection and secondary wire removal is required. If K-wires are needed, it is better to avoid penetration of the wires through the fingertip. The wires can be inserted from proximal-dorsal to distal-volar. Two wires should be used in a crossed fashion in order to enhance stability and provide rotational fixation.

Surgically, the DIP joint is approached through a dorsal transverse incision; this usually gives adequate exposure of the joint. Proximal or distal extension is always possible if more space is needed. The extensor tendon is identified and a transversal tenotomy is performed. In most patients there are significant osteophytes proximal and distal to the joint, which have to be removed, especially for cosmetic reasons. Care should be taken distally to the germinative nail matrix, which starts a few millimetres distal to the joint line. Violation of this structure can lead to severe permanent nail deformity. Both parts of the joint are now prepared for fusion. A power-saw is used for the proximal part but the bone resection should be kept as minimal as possible, in order to avoid excessive shortening of the finger. The distal part can be prepared with the rongeur. The goal is to achieve joint fusion in 5–10° of flexion. This modest amount of flexion gives a functionally good position with an optimal cosmetic appearance. For screw insertion, the inside out technique on both parts is the easiest way to place the screw correctly. The insertion point is in the central part of the osteotomy surface on both sides. The screw channel should point to the dorsal recess of the PIP joint in the middle phalanx, while a straight subungual direction is optimal in the distal phalanx. These positions achieve the desired slight flexion. The distal phalanx is over-drilled in the usual lag screw technique and the screw should be placed flush to the surface of the subungual bone. Correct screw placement and good contact of the osteotomy site have to be checked by fluoroscopy during the operation. It is important to lift the hand from the operating table and check the position of the fused joint relative to the other fingers. Care should be taken to ensure that the rotation of the finger is correct. Tightening the screw might rotate the finger to the ulnar side. It is not mandatory to re-suture the extensor tendon but, if this is done, only a few stitches of fine absorbable suture material should be used. The joint is protected for 6 weeks with a removable DIP splint. Bone healing is then confirmed radiographically.

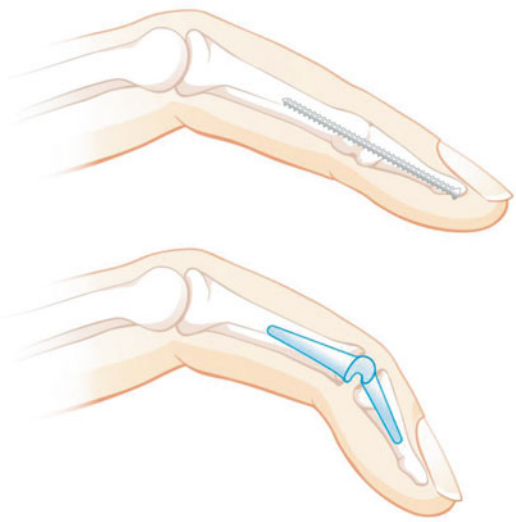

Fig. 6.5 Schematic drawing of a DIP fusion with a screw and a DIP arthroplasty with an original Swanson silicone implant

DIP arthroplasty is another surgical option in this patient group (Figs. 6.5 and 6.6). The same surgical approach as for DIP fusion can be used. The tenotomy of the extensor tendon should be made in such a way that the extensor tendon can be reattached easily. Alternatively, an extensor tendon split can be performed, although it might be difficult to get full access to the joint, remove the osteophytes, and still preserve the extensor

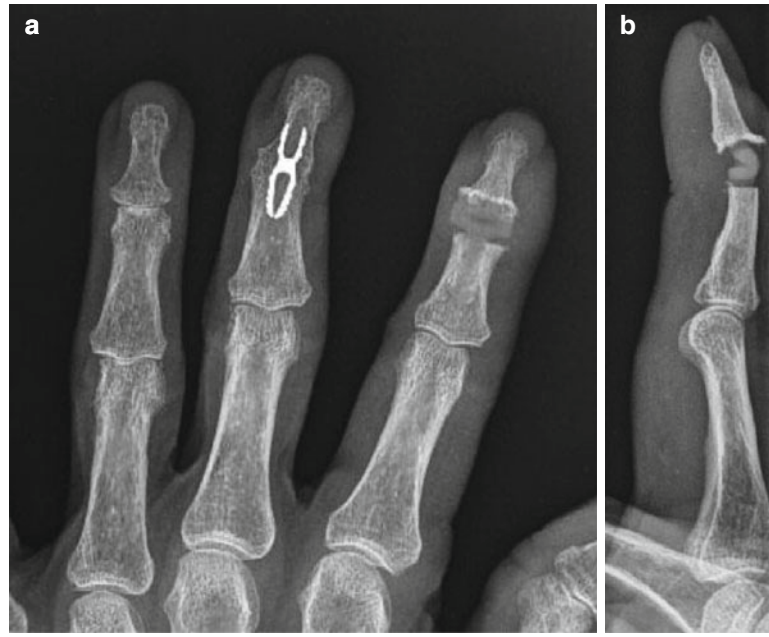

Fig. 6.6 (**a**, **b**) DIP arthroplasty with a Silastic implant on the index finger and fusion of the DIP joint in the middle finger with a memory metal device

tendon insertion. After removing the osteophytes, the bone resection line is marked with the trial implant. A Swanson original implant size 00 usually fits well (Fig. 6.7). After bone resection, the two medullary canals have to be prepared and a trial reduction is performed. The implant should lie smoothly in the bone without bulking. The final implant is then inserted and the extensor tendon re-attached. Passive motion should not be tested, as it violates the extensor tendon fixation. The joint is then immobilized for 5–6 weeks with the aim of achieving around 30° active mobility with enough stability for pinching.

Pearls and Personal Recommendation: Surgical Treatment

The volar approach to PIP arthroplasty has at least theoretical advantages over the other approaches.

DIP fusion with screw fixation allows immediate mobilization of the other finger joints.

DIP arthroplasty is an interesting alternative to DIP fusion.

Outcome, Including Literature Review

Most publications on replacement of the proximal interphalangeal joint mix the indications and only very few authors focus on patients suffering from primary OA of the fingers. Most series have shown that patients with rheumatoid arthritis had a poorer outcome, due to pre-existing deformity that could not be corrected with the implant [23]. Overall, the results of this procedure in osteoarthritic joint destruction are quite uniform. Pain relief is good to excellent, the average range of motion for almost all implants, including the newer designs, is 40–60°, and there is a high recurrence of pre-existing deformities. In most series, the range of motion could not be improved, and no clear correlation between preoperative mobility and postoperative range of motion is to be expected [22]. The newer designs do not improve the active range of motion, moreover they have a greater potential for complications compared with silicone implants [33, 34].

We have started to use our own implant (CapFlex®), a non-cemented real resurfacing prosthesis with short stem fixation and a modular

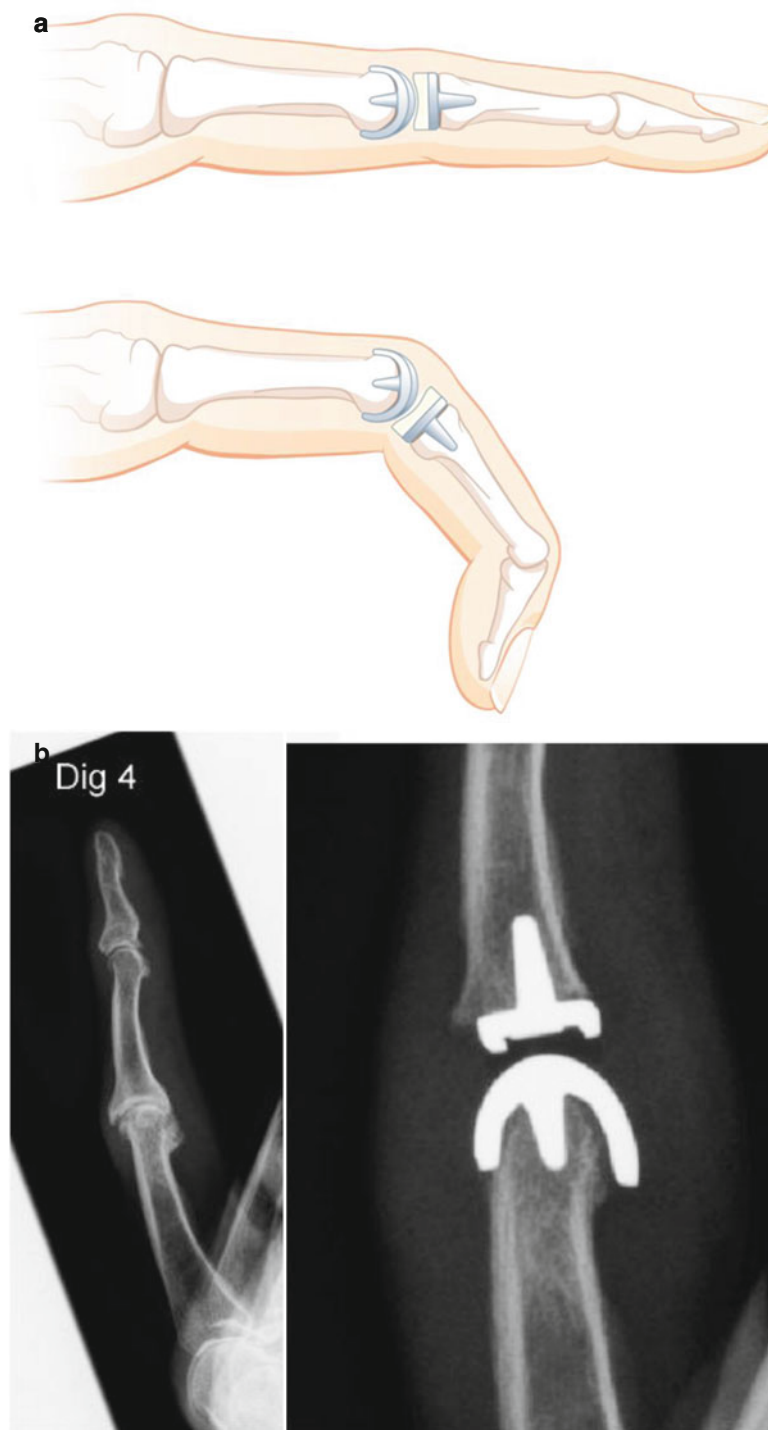

Fig. 6.7 New PIP joint implant (CapFlex®) as resurfacing prosthesis with minimal bone resection and un-cemented fixation with short stems. (**a**) Schematic drawing. (**b**) Preoperative and postoperative radiograph 6 weeks after implantation with good osteointegration of the prosthesis and no secondary dislocation

polyethylene inlay, in different sizes to allow optimal collateral ligament tension. The preliminary results are promising and we plan to use this implant more widely.

PIP joint fusion gives reproducible results regardless of the technique used. Hardware irritation is possible with all techniques and might require metal removal [28].

DIP joint arthrodesis also gives reproducible results but screw fixation is more convenient in most cases [32]. Our own series of 107 DIP joint fusions [35], performed with 2.0 mm screw fixation, showed a solid fusion 6–8 weeks postoperatively in 96 % of the cases. The screw had to be removed in 35 % of the joints, interestingly more often in the two radial digits than in the two ulnar fingers. Mal-union with a residual deviation of more than 5° was observed in 14 % of the patients. Overall, patient satisfaction was high. From these results we can conclude that screw placement flush to the bone surface and careful positioning of the arthrodesis, especially of the rotation, is essential.

For DIP arthroplasty, only few series are available. Wilgis [26] report about 38 digits treated with Silicone arthroplasties with a mean of 10 years follow-up. Less than 10 % of the implants had to be removed and the average range of motion was 33°. Similar results were found by Brown [27], in 13 patients with 21 flexible silicone implant arthroplasties good to excellent results with only one complication was reported. He considers DIP arthroplasty as an alternative to DIP joint fusion. In a recent communication by Zweifel et al. [36] 123 consecutive DIP silicone arthroplasties with two different techniques: one with tendon sparing, and one with tenotomy and subsequent tendon refixation were analyzed. Good pain relief was achieved and 20–30° residual range of motion. No long-term results of this series are yet available.

Pearls and Personal Recommendation: Outcome

PIP arthroplasty, regardless of the implant, has quite uniform results with good pain relief and an average range of motion of 40–60°.

The more complex implant designs have not yet proved superior to silicone implants.

DIP fusion with screw fixation provides good fusion rates and the procedure has high patient satisfaction. DIP arthroplasty may be an interesting alternative.

Complications of Treatment

The complication rate in PIP arthroplasty is significant and the following section addresses the problems. While the main problems of silicone devices are implant failure and cystic bone formation with time [23], more complex joints might show implant loosening and joint dislocation. In the long-term follow up, it is to be expected that 10–30 % of the silicone implants at PIP level show a fracture. This is clearly less than in the MCP joints and does not always mean revision surgery. In comparison with the MCP joint, the rate of silicone synovitis is less and in our experience only a few cases need revision for this problem. As already mentioned, recurrence of pre-existing deformity is high. The overall revision rate in the literature varies from 2 % up to 13 % [23]. Our own series of 612 consecutive PIP silicone arthroplasties over 10 years, with the majority of cases operated on for OA, showed a revision rate of 5.5 % [37]. The main reasons for revision were pain, limited range of motion and joint deformity, mainly ulnar deviation. Most patients showed a combination of these problems. Revision surgery gave good to moderate pain relief, no change in the range of motion, and a high recurrence of joint deformity.

The newer generation of prostheses, including pyrocarbon, ceramic and other resurfacing implants, show a relatively high complication rate with implant dislocation and problems in bone fixation in non-cemented devices [34, 38–40]. A permanent squeezing, unrelated to pain, was observed with some of the implants.

Conclusions/Personal View

Personal Top Ten Pearls: Osteoarthritis of the Fingers

Primary osteoarthritis of the PIP and DIP joints is very common and will be one of the growing markets for surgical treatment in the future.

There is increasing evidence that genetic predisposition is a major factor in disease development.

OA of the fingers is an incurable disease and all attempts to treat this condition conservatively are limited to modifying the symptoms and, at best, slowing down the progression.

Our standard treatment for painful destroyed PIP joints is arthroplasty, with joint arthrodesis for DIP joints.

So far, the more complex two-component PIP prostheses have failed to perform better than silicone implants. At the moment, therefore, the silicone spacer remains our standard implant.

We prefer the volar approach for PIP arthroplasty in patients with OA.

PIP arthroplasty is indicated in the index finger as well as in the other fingers, but immobilisation during rehabilitation is prolonged in order to achieve sufficient lateral stability.

Revision surgery for PIP arthroplasties gives good pain relief but does not improve the range of motion; recurrence of the deformity is to be expected.

Screw fixation is our preferred method for DIP arthrodesis.

There may be a future potential for DIP arthroplasty, especially in the ulnar fingers, but no long-term results of this procedure are available yet.

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